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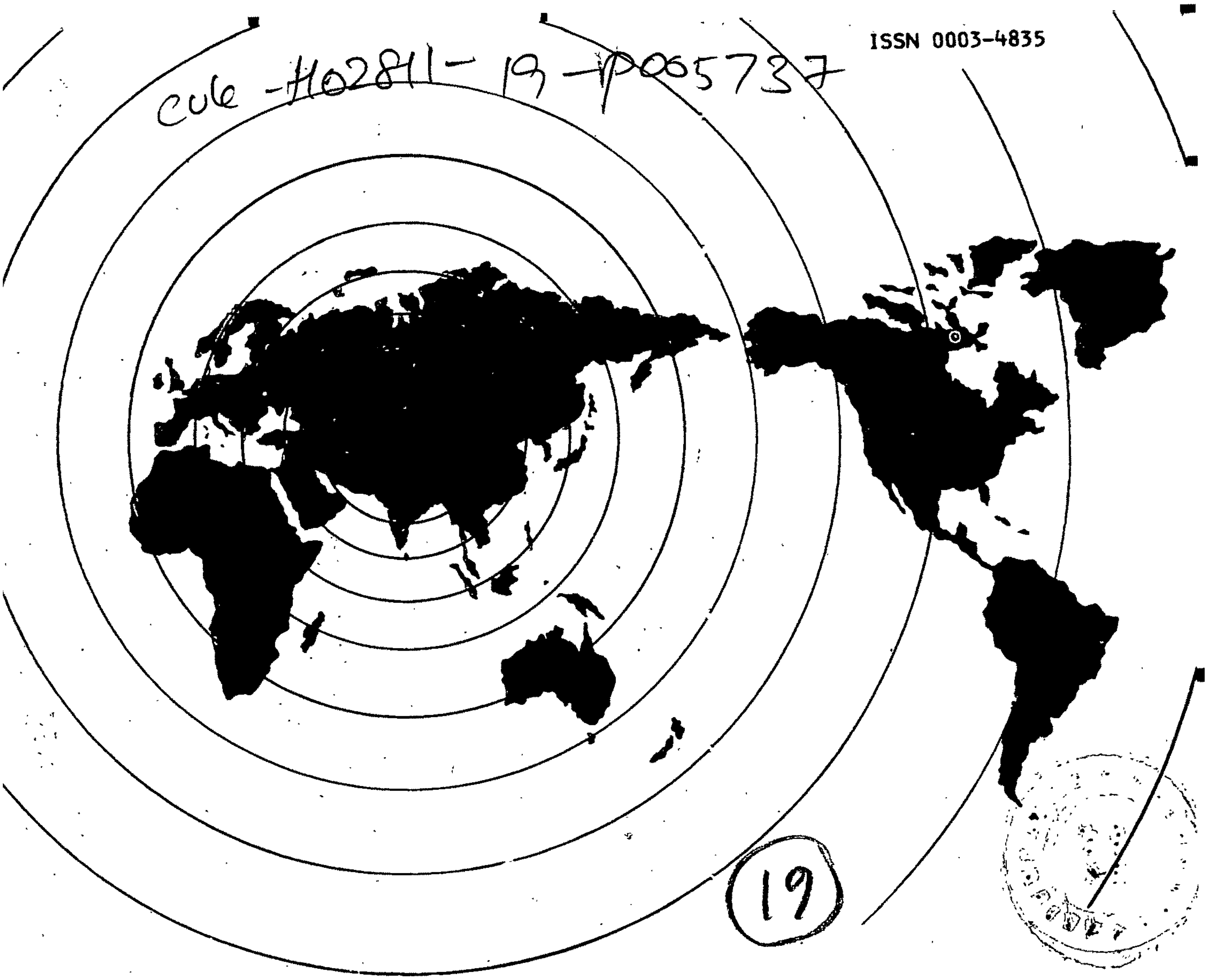

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AN ESSAY ON INFORMETRICS: A STUDY ON GROWTH AND DEVELOPMENT

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Examines the scope of 'informetrics' in relation to metric studies of information and publications such as bibliometrics, scientometrics and librametrics. Suggesis a comprehensive definition of informetrics to cover all aspects of study given in definitions of other writers, particularly Morales. Gives a brief account of the growth of literature in informetrics. Surveys measurement techniques in a number of areas such as growth of literature, efficiency scale for a) document supply, b) translations, c) bibliographies, d) SDI services, e) information products and services. Mentions the usefulness of information in decision making.

Man invented methods of measurement perhaps at the very dawn of civilisation to meet his day-to-day needs. In the beginning, measurement was related mainly to length, breadth, weight, and volume. With the progress of civilisation, man understood the concept of time, and invented devices to measure it. As science progressed, need arose to measure innumerable physical phenomena like heat, light, electricity, and so on. Devices were invented and standards of measurement were determined for all.

For a long time measurement was the field of study mainly of physical scientists and mathematicians. Gradually, it started spreading to other areas. Slowly various measurement methods sprawled to social sciences as well, and subjects like econometrics and sociometrics developed.

The studies on 'informetrics' started way back in 1896, when F Campbell advanced the idea for the first time of the scattering of information[1]. However, he did not coin any term for such studies. Cole and Eaeles in their publication on the history of comparative anatomy analysed the literature on the subject applying statistical methods and called it 'statistical analysis' [2]. Hulme used the term 'statistical bibliography' in 1923 for such studies [3]. Ranganathan used the term 'librametric studies' [4]; he implied the measurement of various library activities and services using mathematical and statistical techniques.

Pritchard coined the term 'bibliometrics' to denote a new discipline where quantitative methods were employed to probe scientific communication processes by measuring and analysing various aspects of written documents [5]. The term 'bibliometrics' has found wide acceptance.Diverse interpretation of the term have been put forward by some authors [6]. Schinidmeir defined it as the application of mathematical methods to bibliographical, information and library activities [7]. Kerius [8], Lawani [9], Hjerppe [10] also tried to show relationship of bibliometrics with library and information science and in certain cases with science of science. We shall also discuss about the definition and scope of bibliometrics later in the article.

In 1979 Nacke for the first time, defined informetrics as 'the application of mathematical methods to the investigation of information science objects, with the aim of describing and analysing their properties and laws in order to optimise these objects in decision making [11]. This definition is inadequate, as the definition considers only the investigation of 'information science objects' and not information science activities and information itself. According to the definition, informetrics aims to describe and analyse properties and laws of information science objects.

It needs to be pointed out here that informetrics not only describes and analyses the properties and laws of information science objects, but also establishes laws employing mathematical and statistical methods relating to the growth, propagation, use and decay of information. Morales defines informetrics 'as the metric discipline concerned with the study of mathematical and statistical methods and models and their application to the quantitative analysis of the structure and properties of scientific information and the patterns and laws of scientific communication processes including identification of the laws proper' [12].

According to Morales, informetrics is concerned with the study of mathematical and statistical methods and models and hence is an integral part of mathematics. However, we feel that informetrics should be concerned mainly with the application of mathematical and statistical methods and models to measure the diverse aspects of any subject/discipline. Indeed in the application of these methods and models to various subjects, a knowledge of the subject is a prerequisite or required at an equal measure with the methods of application. Specific courses on mathematical methods and models would be forming part of a course of study on informetrics when informetrics is fully developed as an independent discipline.

The next point in Morales' definition is the analysis of the structure and properties of scientific information using mathematical and statistical methods and models. Now, the question arises should we only analyse the structure and properties of information without any objective? If not, then what is the objective? The objective is missing in the definition. Moreover, Morales considers only scientific information* in his definition. Some laws like the law of scattering of publications and law of obsolencence of publication are based on scientific publications. If these laws are extended to non-scientific publications (e.g. humanities publications) they may fail. But, laws relating to the propagation of information may be equally applicable to non-scientific publications as they are applicable to scientific publications. The way the efficiency of scientific information systems, services and products can be studied, the same methods can be employed for non-scientific information systems, services and products. It is not necessary that all laws pertaining to a field of knowledge should be equally applicable to all its branches. Some laws will be applicable to all its branches and some will have restricted applications. We can take the examples from biology. Here some laws are equally applicable to both plant and animal sciences, and some are applicable only to plant sciences or animal sciences. For, the growth of animal body takes place according to a fixed pattern which is not the case with plant bodies. Animals always inhale oxygen and exhale carbon-di-oxide, but the plants do the same at night, reverse during the day. Nevertheless, both plants and animals are covered by biology. Hence informetrics also should cover scientific as well as non-scientific information.

From the foregoing discussion, it is clear that both the definitions suffer from certain limitations. We are trying to put forward another definition covering all aspects of informetrics. We, however, do not claim that our definition is absolutely free from limitations. We have only tried to remove obvious limitations and to make the definition comprehensive. We intend to define informetrics as that branch of knowledge which employs mathematical and statistical techniques to measure publications and concepts, their growth, propagation, use and decay of information; establish laws governing these factors, and study the efficiency of information systems, services and products, as well as explore the intra - and interrelationship of disciplines. The main objective in metric studies of information (concepts and documents) are to provide processed data leading to reliable indicators for a) research and development in all disciplines, b) policy making and planning, and c) management of institutions, projects, programmes and activities.

Now, let us examine this definition keeping in view the eleven aspects of informetrics enumerated by Morales. The eleven aspects enumerated by Morales are:-

"i) quantitative growth of literature
ii) information obsolescence and scattering
iii) efficiency of information products and services in science, technology and production
iv) efficiency of information systems and information establishments in general

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**Scientific information here is construed as information relating to science in the conventional meaning of science, as is understood in most western countries.*

v) the role of different kinds of documents as means of scientific communication
vi) the role of information channel in scientific communication
vii) information relevance and pertinence
viii) ranking of periodicals and serials by various parameters
ix) overlapping of subject contents between periodicals and serials
x) citation habits of scientists and the growing role of citation analysis
xi) intradisciplinary and interdisciplinary relation as determined on the basis of bibliographical reference."[12]

The growth aspect of literature has been taken well care of in our definition. The second aspect relates to information obsolescence and scattering. This aspect has been covered by the term propagation and decay. These terms are obviously more comprehensive than obsolence and scattering.

The third and fourth aspects cover the efficiency of information systems, services and products. These also have figured in our definition.

The fifth and sixth aspects relate to the role of documents as well as information channels in scientific communication. Documents and other information channels are, in fact, the means of propagation of information. Hence, they are well-covered in the definition.

The seventh aspect deals with the relevance and pertinence of information. The relevance and pertinence of information are invariably linked with the use of information. This aspect has also been included in the definition.

Ranking of periodicals and serials and overlapping of subject contents in periodicals and serials (aspects viii & ix) are again the phenomena of propagation.

Citation habits of scientists is the manifestation of the use of information. It may be argued that all the articles cited by a scientist in an article might not have been used by him. In many cases this may be true. To what extent this is true, informetrics attempts to find out that. Even though, some articles etc referred by a scientist have not been used by him, but he refers to these documents with the intention that others may use them. So, citation habit reflects two things:

i) documents used by the citer and
ii) documents may be used by others

Citation analysis (aspect x) is a method employed in informetrics for determining the propagation, use, decay etc. of information. Determination of intra- and interdisciplinary relations has also been covered in our definition.

Morales[12] considers informetrics as a scientific information activity. Some laws like the law of scattering of publications and laws of obsolescence of publications are based on scientific publications. If these laws are extended to non-scientific publications (e.g. humanities publications) they may fail. But, it has already been mentioned that laws relating to the propagation of information may be equally applicable to non-scientific publications as they are applicable to scientific publications.

RELATIONSHIP WITH OTHER SUBJECTS

Informetrics and Bibliometrics

Informetrics and bibliometrics seem to be very close to one another. Etymologically bibliometrics is composed of two distinct parts, i.e. biblio and metrics. The prefix biblio is a loan word from Greek and means book, and the suffix metrics, coined from the Greek word 'metrikos' means the science of meter i.e. measurement. Combining the two, we find that bibliometrics connotes the science of measurement pertaining to books. In our context, we can replace the word 'book' with 'document' and bibliometrics turns out to be the science of measurement relating to documents, especially the number of documents; whereas informetrics cover the metric studies relating not only to documents but also to concepts. As such bibliometrics becomes a subset of informetrics. Informetrics comprises informetric studies pertaining to all disciplines.

Informetrics & Librametrics

Library science is a well-recognized discipline and the metric studies pertaining to library science can be termed as librametrics. Various library activities are measurable. For example, the average number of books, that a person can classify, catalogue, accession, or even shelve within a given span of time (e.g. an hour, a day etc) can be determined. Similarly, the average time required for charging or discharging a book, writing a call number on the book, putting various labels and stamps on a book, all can be determined employing mathematical and statistical techniques. The number of books issued or the number of queries answered per day can also be measured. Here the term book can be used, because till now, books remain the most predominant factor in libraries. In the case of metric studies, what is true of books is also true for other documents in a library. The library activities discussed above and certain other activities are measurable. All such library activities as are measurable are encompassed by librametrics. The study of the number of books issued, or the number of queries answered within a given length of time is covered by librametrics as part of informetrics.

Informetrics & Scientometrics

Ethymologically scientometrics means the study relating to the measurement of science. Science can be measured from a number of points of view like the production of graduates, postgraduates or Ph.ds of science; the establishment of research institutions, the institutions of study and teaching of science; the deployment of scientific manpower, brain drain; expenditure of R&D; founding of the media of scientific communication, e.g. primary and secondary scinetific periodicals; scientific literature; and scientific information systems, services and products. The metric studies of all these aspects fall within the ambit of scientometrics. The area of scientometrics which deal with scientific information is also covered by informetrics. It is to be noted that a very large share of the literature of informetrics pertain to scientometrics.

Growth of Informetrics

From the foregoing discussion, we find that bibliometrics is an integral part of informetrics, part of librametrics and scientometrics are also covered by informetrics. In fact, metric study of information pertaining to any field of knowledge fall within the purview of informetrics.

The growth on informetrics can be measured from the *Bibliography of Bibliometrics and Citation Indexing Analysis* published by the Royal Institute of Technology. Library (Report TRITA - LIB 2013) [13] and a supplement to this bibliography appeared in Scientometrics [14] and also a bibliography on the subject compiled by R Pal and others, INSDOC covering the period 1980-84 [15]. The graphical representation of the literature indicates a steady growth and peak in 1977 and thereafter a slight fall and again a steady rise. According to Morales [12] the slight fall during 1977-1980 is due to the fact that the coverage during the period is not comprehensive. It should also be pointed out that the works of Eugene Garfield published in his *Essays of an Information Scientist* were not included in the two bibliographies covering the period 1917 to 1980 [13,14].

MEASUREMENT TECHNIQUES

Growth of Literature

Usually two methods are being followed in the measurement of the growth of literature. If the subject is broad, usually the number of entries per year appearing in the secondary services on the subject is determined, and on that basis the growth is measured. For instance, to measure the growth of chemical literature, the number of entries in the *Chemical Abstracts* is counted for a specific period, the difference of entries for the two successive years which is always positive shows the growth. *Chemical Abstracts* being a comprehensive service on the field, there is little chance of any big error in the computation of the growth. However, it must be pointed out that even the coverage of *Chemical Abstracts* is not cent per cent. A study of the coverage of Indian chemical literature in the *Chemical Abstracts* indicated that the coverage on chemistry was about 90% and of chemical technology was about 60% only. When the coverage of *Chemical Abstracts* is nearing 6 lakhs items a year, even if several hundred or thousand items are missed, it does not affect the computation of overall growth rate very much; of course, it affects the total number. Most of the abstracting services in the world are not so comprehensive as the *Chemical Abstracts.* For example, *Physics Abstracts, Mathematical Reviews, Excerpta Medica, Index Medicus* are not at all comprehensive. The coverage of Indian literature in these services vary between 10% to 60% [16-18]. The coverage from other developing countries may be still low. Measuring the growth basing any one of these services in the respective fields may not give a comprehensive and true picture.

Nowadays, many countries are bringing out their national abstracting or indexing services, India being one of them. The computation of the growth of national literature basing on these services, may at times lead to grave errors. Studies[19,20] have indicated that a great deal of Indian scientific contributions are being published abroad. As such, they are not getting reflected in the *Indian Science Abstracts*. What one finds in *Indian Science Abstracts* is not the true reflection of India's scientific contribution.

While measuring the growth of literature on a broad subject, it is always risky to depend on a single international secondary service. Covering, of more services may yield better results, but there is huge amount of overlapping among the various services on the same subject which needs to be taken care of; otherwise, the figures will get terribly inflated.

When the growth is measured on a narrow subject, usually several sources are consulted to prepare a bibliography. As such, duplicate entries are eliminated. This method is more or less a foolproof method.

Measurement of the growth of literature on a subject is different from the measurement of the growth of knowledge on the basis of literary output.

When a person or a group is engaged in conducting research on a topic, they send a write-up in the form of short communication before the research is complete with a view to informing others about the research work undertaken. As the research work progresses, a paper may be presented in conferences to have a discussion on the topic to get a direct feedback from the fellow scientists. Finally, when the research work is complete, a full-length paper is published which we may call the 'basic paper'. After the publication of the basic paper, this may also appear in cover-to-cover translated periodicals. If we consider the contribution to knowledge, the basic paper alone serves the purpose. Some learned comments may also add to knowledge. Even though several papers on the topic have appeared, as far as the growth of literature is concerned, all the papers are to be taken into account. But for the growth of knowledge, the full-length paper alone should be taken into account. Knowledge factor remaining constant, the literary output grows for several reasons, besides those discussed above.

i) Some technical reports also appear in the form of conference papers or research papers.

ii) Papers presented in a conference sometimes also appear in the form of articles in periodicals.

iii) Some authors get the same article published in different journals with minor change and no change.

(iv) An invention patented in various countries of the world result in number of patent specifications.

v) When a conference proceedings is abstracted or indexed; an entry is given for the conference proceedings itself apart from the entries given for all the papers presented in the conference. As a result, the literary output gets an increase by one because of the entry for the conference document.

For measuring the growth of knowledge, previews or short communications, comments (not contributing to knowledge), translations, conference paper/s, technical reports, resulting from the same basic paper should be excluded.

Efficiency of Information Systems, Services and Products

The efficiency of information systems can be measured by taking into account the efficiency of its information services and products.

Information services comprise supply of documents i.e. books, photocopies, microfilms, microfiche, etc.; translations; bibliographies; answers to queries; etc.

Efficiency of Document Supply

The efficiency relating to the supply of documents can be measured in terms of time and the number of documents supplied. The efficiency can be calculated on monthly basis. (Fig.1).

Efficiency of Translation Supply

The efficiency of translation service can be measured by taking into account the number

Fig. 1: Efficiency Scale for Document Supply

	Percentage of requested documents supplied within a month	Efficiency
1	Above 90%	Excellent
2.	Between 75% to 90%	Very good
3.	Between 60% to 75%	Good
4.	Between 50% to 60%	Fair
5.	Below 50%	Inefficient

of pages translated, the time taken for the supply of translation, and the quality of translation.

The time taken for the supply of translation depends mainly on

a) availability of the document to be translated; and

b) availability of the translator

First Case - Document and Translator both available with the agency.

If the document is supplied by the user or available with the translation agency, and the translator also is available with the agency, the time taken for translation is least. It can reasonably be expected that the translation of a 10 page document (this we are taking as a standard) will be supplied in a week's time. The translation of a 10 - page document will occupy about 25 to 30 typewritten pages. (Fig.2).

Fig. 2: Efficiency Scale for Translation - 1

Time taken for supply of translation	Efficiency
Upto 7 days	60%
between 8-15 days	40%
Above 15 days	20%

Now we can measure the overall efficiency taking into account the quality percentage. We shall discuss about the measurement of quality later in this article.

Second Case - Document available, but translator not available with the agency.

In many cases, agencies get translation done through panel translators. Sending the document to the panel translator, getting the translation back from him, and editing takes time. The entire process may take 15 to 20 days. Taking into account this factor we can have a scale for measuring efficiency (Fig.3).

Fig. 3: Efficiency Scale for Translation -2

Time taken for supply of translation	Efficiency
Upto 4 weeks	60%
between 4-5 weeks	40%
Above 5 weeks	20%

Third case: Document not available, but the translator available with the agency.

In our country, almost centpercent demand for translation is from foreign languages, and the availability of the foreign language documents is very low. As such, most of the foreign language documents are to be procured from abroad, which takes time varying from less than one month to more than one year. Basing the experience of INSDOC, we can take the average procurement time of foreign language documents as 10 weeks. For this scale, we are to add the procurement time alongwith the translation time. (Fig.4).

Fourth Case - Document not available, translator not available with the agency.

We can derive this scale simply by merging Efficiency Scale - 2 with Efficiency Scale - 3. (Fig.5).

Fig. 4: Efficiency Scale for Translation-3

Time taken for supply of translation	Efficiency
Upto 11 weeks	60%
between 11-12 weeks	40%
Above 12 weeks	20%

Fig 5: Efficiency Scale for Translation - 4

Time taken for supply of translation	Efficiency
Upto 15 weeks	60%
Between 15-16 weeks	40%
Above 16 weeks	20%

When a translation is being supplied by an information/translation agency, it is expected that the agency will take some measure of quality control. In other words, we take it for granted that the translation supplied by a recognised agency will not be utter rubbish excepting some extraordinary cases. As such we give an weightage of 40% for the quality of translation. For the measurement of quality, we can have a scale. (Fig.6)

Fig. 6: Quality Scale

Satisfaction level	Weightage
Highly satisfactory	40%
Satisfactory	30%
Tolerable	20%
Unsatisfactory	0%
Totally unsatisfactory	20%

This scale can be attached to each piece of translation and the user may be requested to inform about his satisfaction level according to the scale.

For measuring the overall efficiency of a piece of translation we are to take the help of the specific Efficiency Scale applicable to the situation and the Quality Scale.

Suppose, an order was placed for the translation of a 10 page German language document into English. The document had to be procured from abroad and the agency was having the translator. The translation was supplied in 10 weeks and the quality of translation was found to be satisfactory. In this specific case, Efficiency Scale No.3 is applicable. From the scale, we get the percentage of efficiency as 60%, and from the Quality Scale, we get the percentage of efficiency as 30%. So, the overall efficiency adds upto 90%.

For measuring the overall efficiency, efficiency has to be measured piece by piece, and then an average has to be calculated. The average value has to be compared with the Efficiency Scale for Document Supply. Suppose the average works out to be 63%, comparing this percentage with the scale we find that the efficiency is good.

Allowances have to made for difficult languages like Chinese and Japanese, or less known languages like Romanian or Hungarian. For reverse translation also e.g. from English to German, or any other foreign language similar allowances will have to be made.

The scales have been made taking a 10 page document as standard. The time taken for translation is directly proportional to the length of the document, to be precise, the number of words in a document. If one week is optimum for the translation of a 10 page document, then 2 weeks time will be optimum for the translation of 20 page document and so on. This factor needs to be kept in mind, while measuring the translation service.

Efficiency of Bibliographies compiled on request

The efficiency of bibliographies compiled on request may be measured in terms of exhaustivity, time taken for the supply, as well as the relevance of the documents included in the bibliography. The measurement of these parameters poses a number of problems. The exhaustivity of a bibliography can be determined only when an exhaustive bibliography on the topic is compiled for the purpose of comparison which is highly time-consuming. The exhaustivity is not measurable when the bibliography is selective. The time taken for the compilation of bibliographies varies widely depending on many factors. If the bibliographer finds a good review article of the topic, the compilation of a bibliography takes little time. On the other hand the compilation of a bibliography will be highly time-consuming on a topic, say on a rare insect, whose literature is scarce and widely sparsed. The relevance of the articles, can be decided only by an expert, or the user who asked for the bibliography.

In the circumstances, it is better to elicit the user's opinion on all the three parameters to measure the efficiency (Fig.7).

We can grade Highly satisfactory - 80%, Satisfactory - 60%, Tolerable - 40%, and unsatisfactory - 20% for calculating the efficiency.

Efficiency of the Answers to Queries

For measuring this, we have only two parameters to take care of. They are (i) Time required for answering the query and (ii) the relevance of the answer to the query, and the same efficiency scale as given in the Bibliography service can be used here omitting the Exhaustivity parameter.

Efficiency of SDI Services

For SDI services also, the three factors responsible for the determination of efficiency are exhaustivity, timeliness and relevance. Efficiency scales for measuring the service have already been evolved, and it is measured on the basis of the data obtained through feedback cards.

Efficiency of Information Products

By information products we mean here current awareness services, indexing services, express information services, abstracting services etc. For measuring the efficiency of all these services, we are to consider the coverage, timeliness, ease of handling, and index in some cases.

a) Current Awareness Service

For current awareness service, the criteria for the measurement of efficiency should be primarily the timeliness. Relevancy, despite being an important factor, cannot be stressed to much because current awareness services in many cases are directed for world users, who scan through the pages of the service to find if anything of his interest has been published. We cannot also lay too much stress on exhaustivity, since exhaustivity adds not only to the cost, but also to the delay. So a current awareness service has to maintain a balance between timeliness and exhaustivity. Now, the question arises, how to measure the timeliness? After the publication of a periodical/serial, it takes from less than a week's time to several months to reach the agency bringing out the service. However agencies can reduce this time by getting the photocopies of the title pages of the documents by airmail. So for agencies, the measurement of time should be counted from the date of issue of the document by the publisher, and for local current awareness services, from the date of receipt of the publication in the library. If we take 7 days as the transit time by airmail and 15 days time for processing, printing, despatching then three weeks time become optimum for current awareness services being brought out by agencies. For the libraries bringing out current awareness services, we are not taking into account the transit time, because here the measurement of time is from the date of receipt of periodical issue in the library. Here also

Fig. 7: Efficiency Scale for Bibliographic Service

	Exhaustivity	Timeliness	Relevance
Highly satisfactory			
Satisfactory			
Tolerable			
Unsatisfactory			

Fig. 8: Efficiency Scale for Current Awareness Services

National/International CAS Time lag	Efficiency	Local CAS Time Lag	Efficiency
Less than 3 weeks	80%	Less than 2 weeks	80%
Between 3 & 4 weeks	70%	Between 2 & 3 weeks	70%
Between 4 & 5 weeks	60%	Between 3 & 4 weeks	60%
Between 5 & 6 weeks	50%	Between 4 & 5 weeks	50%
Above 6 weeks	Inefficient	Above 5 weeks	inefficient

for processing, printing, etc. we can take 15 days time as optimum and have scales for measuring the efficiency of CAS. Of course, some percentage, say 20% should be allotted for such parameters as coverage, arrangement and index (Fig. 8).

b) Indexing Services

For reducing the publication delay, the CAS in many cases reproduce the title page itself, and the same is arranged alphabetically by the title of the periodical. As a result, processing time is reduced to the minimum. These services do not lay much importance on exhaustivity. Timeliness is the main criterion for such services. For indexing services, exhaustivity being one of the main criteria, cannot compete with the timeliness of CAS. Moreover, indexing services, in many cases, being voluminous publications, have to arrange entries in a systematic way for easy searching of required information. In addition, indexes are also provided for multiple approach. All these require time. So, a time lag of two months seems to be optimum for such services. We can have a scale for measuring the timeliness of an indexing service (Fig.9).

For measuring the exhaustivity, first of all an exhaustive list of core and allied periodicals on the subject needs to be proposed. The list of periodicals covered by the service can be compared with the exhaustive list prepared for the purpose. We can allot 60% for core periodicals, 30% for allied, and 10% for alien periodicals. Let us demonstrate the measurement with the aid of an example. Suppose a service covers 40 core periodicals out of 50, 210 allied periodicals out of 300 and some alien periodicals.

Efficiency of core periodicals

$$= \frac{40 \times 100}{50} = 80\%$$

80% out of 60% allotted for core periodicals

$$= \frac{60 \times 80}{100} = 48\%$$

Efficiency for allied periodicals

$$= \frac{200}{300} \times 100 = 70\%$$

70% out of 30% allotted for allied periodicals

$$= \frac{30 \times 70}{100} = 21\%$$

For allotting percentage for alien periodicals, discretion will have to be used, as it is difficult to compile a list of alien periodicals which may go into thousands, and no service

Fig. 9: Efficiency Scale of Indexing Service – Time

Time Lag	Efficiency
Less than 2 months	100%
Between 2 & 3 months	80%
Between 3 & 4 months	70%
Between 4 & 5 months	60%
Between 5 & 6 months	50%
Above 6 months	Inefficient

can afford to cover all, as it would not be cost-effective. Suppose, in this case 4% is given for the alien periodicals then the total efficiency for exhaustivity adds upto 48% + 21% + 4% = 73%.

The ease of searching is dependent on the arrangement of entiries in the text portion, as well as the number and type of indexes provided. For measuring the efficiency, marks will have to be allotted for

Arrangement - Classified
Alphabetically subject-wise
Non-alphabetical subject grouping

Arrangement - any other

Indexes - Subject - exhaustive
- key word
- any other

Author

Sponsor/Affiliation

Others
See and See also References

It is difficult to provide a general formula here. Because an indexing service arranged alphabetically subjectwise reduces to a great extent the need for a subject index. Again, providing of various types of indexes depends mainly on the subject of the service. For example, a geographical index for a geological service is of great value, whereas for biological service, a taxonomic index will be considered highly important.

For determining the efficiency, a questionnaire may be designed allotting marks on items listed above according to the situation, and survey can be undertaken taking users as the sample.

Taking the average of the percentages for timeliness, exhaustivity and ease of searching the efficiency of a service can be determined.

c) *Abstracting Services*

For bringing out an abstracting service, apart from all the jobs done for bringing out an indexing services, the abstracting of all the items are to be done. Moreover, abstracting services are to provide multiple approaches depending on the subject by way of indexes. Number of indexes as well as depth of indexing is usually more in the case of abstracting services compared to indexing services. Preparation of abstracts and various types of indexes and their subsequent printing obviously involve more man hours and time. Most of the international abstracting services have computerised the production of indexes to a great extent and thereby reduced the time of index preparation a great deal. Taking all these factors into account, we can add two months in each case to the Efficiency Scale of Indexing Services–Time to derive the efficiency scale of abstracting services for time (Fig.10).

Fig. 10: Efficiency Scale of Abstracting Service - Time

Time Lag	Efficiency
Less than 4 months	100%
Between 4 and 5 months	80%
Between 5 & 6 months	70%
Between 6 & 7 months	60%
Between 7 & 8 months	50%
Above 8 months	Inefficient

For measuring the exhaustivity and ease of search, the same procedure can be followed as described under indexing services.

d) *Express Information Service*

This service has originated from the USSR, where it is called Ekspress Informatsia. This service is usually devoted to a very narrow but highly important field of knowledge. All foreign language recent contributions are chosen on the subject, and a digest of the articles (about 1/3rd of the original size) is prepared in Russian. Introduction and other not very important matter are excluded and important formulas, illustrations, etc. are retained. This is done to obviate the need for going through the original. Each issue contains about eight to ten articles, and published four times a month. The time lag between the receipt of periodicals in the library and the issuance of the express information service is about one month.

Like current awareness service in this case also timeliness is more important compared to exhaustivity and quality. As foreign languages are involved here, this factor has to be taken into account while fixing the scale. As the number of articles covered in an issue are only about eight to ten, we can allot about two weeks time for translation to the scale fixed for national/ international current awareness service. The quality of the digests can be measured in the same way as in the case of translation.

METRIC STUDIES OF OTHER FACTORS

There are well-known methods for the study of information about obsolescence, scattering, relevance and pertinence.

Hence they are not being described here. For the ranking of periodicals also, there are well established methods. However the way, any Indian authors are ranking periodicals, there is much as one for improvement. This very aspect has been dealt with in another paper[21].

INFORMETRICS & DECISION MAKING

The development of a country is closely interlinked with its scientific and technological development. The analysis of the scientific and technical information output of a country can identify areas which are weak and need boosting up.

The information agencies or libraries bringing out various information products and rendering various information services can measure the efficiency of the products as well as services to find out how much efficient or deficient a particular service or product is, and measures can be undertaken to remove the deficiency.

Every year there is a considerable hike in the subscription rate of periodicals which is proportionately far more than the increase in the library budget for periodicals. Moreover, there is always demand for new periodicals In the circumstances, every year need arises to drop certain title to balance the number of titles with the budget. The decision to drop certain titles is taken rather arbitrarily. If a rank list of periodicals is prepared at regular intervals through the study, citation study, etc.; the decision making regarding the dropping of certain periodicals becomes logical as well as easy.

Given above are only some examples where informetrics can be used effectively for decision making. Informetrics is a developing subject and it is hoped it will have much wider application in future.

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SPECIAL COLLECTIONS IN NIGERIAN ACADEMIC LIBRARIES

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Special collections are indispensable to many students, researchers and librarians. Their composition makes them vulnerable to pilferage, and mutilation. Should this vulnerability be an excuse for making physical access to these collections a nearly impregnable thicket? They could also be very fragile and they deserve special conservation and preservation techniques. As national treasures, more or less, Nigerian academic libraries should do all they can to acquire, develop and manage them for maximum utilization.

DEFINITION

In this age of critical, bibliographic and textual studies in the humanistic and other disciplines, an age that has witnessed an increasing number of researchers in all fields, people whose research necessitates access to original sources, academic libraries have seen the need to acquire books and allied materials not only of considerable value but also of scarce nature. The departments or sections that assume responsibility for these rare and unusual library materials are variously named: university archives, department or division of rare books, department of special collections. Some of the materials in these collections may or may not be rare or even expensive. The term Special Collection is preferred in this paper because our definition also covers specialized collections in various university departments, faculties and institutes. The elephant and the special collection have one thing in common - they are easy to recognise but difficult to describe or define. A special collection is

> "A collection of books connected with local history, celebrities, industries, etc. or a certain subject or period, or gathered for some particular reason in a library which is general in character[2].

Special collections may be housed in a separate building or within the central library building. Many departmental libraries contain subject-related materials that are rare, such as some materials in the law libraries at Harvard University and University of Illinois in North America. Special facilities within the departmental libraries are sometimes provided for these rarities. Specialized departmental libraries are included in our definition of special collections. Usually, special collections synthesize, correlate and document the history and thought of distinguished people. They are mines of information illustrating the richness of the history, culture and civilization of people throughout the world.

BACKGROUND

The development of special collections in Nigerian University libraries dates back to the establishment of the first university namely the University of Ibadan, in 1948. Because it was the highest institution of learning and because there was no national library in existence, the university library was designated the national depository for Nigerian publications (Nigerian Publication Ordinance of 1950). It thus became compulsory for all publishers in the country to deposit two copies of their books, journals, pamphlets, gazettes, sheets of music, maps, plans etc. in the university library.

These deposits form a substantial part of the University Special Collection. It played this role fully till 1964 when the then Northern Region designated Ahmadu Bello University, Zaria, as the legal depository for all publications emanating from that region. In 1970, the National Library Decree (Decree 29 of 1970) was promulgated and this transferred the role of legal deposit from the Ibadan University Library to the National Library in Lagos[2]. It stated that three copies of all books published should be deposited with the National Library with one copy to be re-directed to the University of Ibadan. Thus, these two university libraries (Ibadan and Zaria) were able to acquire manterials that form part of their special collections.

ACQUISITION

Because special collections constitute a significant portion of primary research materials, Nigerian academic libraries should make conscious efforts to develop them. Since 1857, there has been in America, legal provision for distributing government publications to certain designated libraries and in 1962, the Depository Library Act[3] was enacted which makes the designated libraries provide readers such government publications under their care. Some of these libraries are academic, some more affluent academic libraries set out to deliberately build up rare and special collections from the scratch. In Nigerian academic libraries, substantial part of their special collections have more often been by deposits, gifts or bequests of private collections.

Over the years, the older academic libraries in Nigeria, which include those at the universities of Ibadan, Nigeria, Lagos and Ife have acquired through deposits, gifts, bequests and purchases varying but substantial quantities of special materials. The newer academic libraries are also trying to develop their own special collections. To what extent and under what condition are these materials available to the public researchers and others who have legitimate need for the information they contain?

If the exponential growth of factual information is making it increasingly difficult for subject specialists to keep abreast of developments in their fields, the situation is even worse for librarians in charge of special collections since they handle a substantial part of the sources of these information in subject areas. They are faced with the problems of not only acquiring, housing, organizing and preserving these materials, but also of making them available to users promptly when they are demanded.

The Federal Government, apart from playing the dominant role in higher education in Nigeria, also almost single-handedly finances national research efforts. There is the need to monitor publications emanating from higher institutions and research centres in Nigeria so that they can be made available in special collections of academic and other libraries as well as to clients. At present, there is a chaotic situation whereby, for instance, one cannot easily trace government publications. This constitutes a great obstacle to research efforts since those who are to utilize such publications never have access to them.

Selection of materials in most academic libraries in Nigeria and elsewhere seriously involves faculty members who in some cases play major roles. But faculty members as major selectors have the following deficiencies[4] :

(a) They believe that only they are capable selectors
(b) some do not care and feel that the textbook is enough
(c) Preoccupation with other duties
(d) inclination to laziness
(e) tendency to concentrate selection to narrow field of specialization without any regard for the actual needs of students
(f) insufficient acquaintance with the world of books.

With such deficiencies, to allow faculty members play major roles in selection is dangerous but librarians are not without their own faults which include some of those ascribed to faculty members. Even though a librarian may be well acquainted with the world of books, he may be handicapped when it comes to materials outside his subject area. In respect of some special collections, selection tools are grossly inadequate. It, therefore, follows that a combination of selection tools, opinion of librarians and that of faculty might serve a better purpose. There are, of course, the problems of reviews coming out too late, or not being critical enough and such other deficiencies in selection tools.

Need for acquisition policy

It is important for a special collection department to have a selection or acquisition policy either incorporated in the library's general policy or independent of the general policy. The acquisition policy when drawn and approved by the academic library committee (or any committee that is responsible for the approval) becomes the special collection's librarians' guide. The acquisition policy to be followed is one that requires common sense, wisdom and sometimes the capacity to harden one's heart against sentimentality of booksellers. The special collection librarian must consider the genuine utility of the materials that he buys. The development of an effective special collection requires everlasting vigilance on the part of the librarian to see, that his library does not become merely a warehouse of dead books. He must be vigilant to see that his budget devoted to acquisition is not spent on useless books and manuscripts. He must not only be alert but tactful in fending off unwanted gifts that would make his library a warehouse of junk. The idea to build a "complete" special collection is fallacious. In absolute sense few special collection libraries can be complete. Special collection materials have intrinisic value, association value because they are autographed or contain valuable marginalia, and are difficult to replace. The special collection department should do all the bibliographical work necessary for ordering even when orders are centralized in the library's general order department.

For the selection of special collection in Nigerian academic libraries, the librarian should as a desirable means of acqusition, submit an approved plan to the chief librarian. A selection policy determining what the special collection department would acquire is necessary if all types of materials are not to flood the collection department. Some materials in special collections are historical manuscripts that include papers of political figures, prominent citizens, business leaders etc. They come in as gifts, bequest, purchase, etc. An acquisition policy can determine which is to be retained.

A very popular method of acquisition of special collection is the presentation by a grateful or public spirited collector, of his own specialized library to an established institution. *Jacon M. Lowy Collection* made up mostly of five centuries of Hebraica incunabula was donated by the Slovakia born industrialist and philanthropist to the Crown of Canada. The 2,000 rare volumes are acknowledged as one of the foremost private collections in that field[5].

FACTORS IN BUILDING SPECIAL COLLECTIONS

Most of the Nigerian academic libraries are known not to be eager to acquire manuscripts because of their fragile nature and donors' imposed conditions. Technically, a manuscript is defined as a piece of writing prior to Gutenberg. However, manuscript production did not stop with the invention of printing, hence manuscript records being created exceed materials in printed form. Manuscripts are usually donated to university libraries by members of the university and others who for various reasons think the university library is the suitable repository. Take for example, the case of the University of Ibadan manuscript collection. The core came from private papers of late Herbert Macaulay, Bishop S.C. Phillips, Chief A. Obisesan, Rev. E.M. Dijadu, Rev. I.O. Ransom-Kuti among others.

Manuscripts are acquired not because they are physical objects or autographs but because they constitute historical evidence for the reconstruction of the past, for the interpretation of parallel experience, for the impeachment of false or mistaken or pervated testimony and for the recovery of reality. They are authoritative since they are written by active participants or shrewd and trustworthy observers of events. Nigerian university libraries need to intensify manuscript acquisition since unlike the U.S. and Europe, private collectors are very few. An aggressive acquisition programme as that of the Harvard University is necessary. The Harvard University archives (which is the special collection department of the main library) periodically writes to all (alumni) officers holding permanent position to put a provision in their wills making the University their library executor and leaving all their manuscripts to the university archives[6]. If Nigerian universities do the same, chances are, many will give favourable disposition to it and this will be a rich source of collection, but, since the real selection of materials to be retained begins after a collection reaches the library depository, the letter of transmittal or deed of gift should include clauses to the effect that materials judged inappropriate for permanent preservation will be destroyed, alienated or returned. The deed should also include the handing over of complete right to the librarian relating to materials such as determining public use and photocopying. Donors should be made to realise that they need to accept conditions which are reasonable and which conform with paper manuscript management practice.

For the period of colonisalism in Nigeria, a great wealth of archival materials, mostly manuscripts and printed documents, were accumulated. These materials reflect the social, economic, political, scientific, and spiritual interest of the Nigerian people. The struggle for independence, the civil war and events thereafter naturally resulted in the production of heaps of propaganda materials in addition to the regular official government record making. Ever since, all succeeding government administrations, including the present have contributed to the production of a tremendous volume of documents. Record creation has become an intrinsic aspect of government bureaucratic machinery. A substantial quantity of these government documents have found themselves in the custody of university libraries as part of their special collection.

Government documents constitute the bulk of materials deposited either through depository laws or otherwise, in Nigerian libraries. In 1979, there were 5, 000 government documents in the Special Collections of the University of Ibadan Library[7]. Government publications include all forms of book and non-book publications emanating directly from such government agencies like the ministry and department or that are published on behalf of the government and its agencies by authorised publishers. They contain, apart from statistical data, primary, current and historical records. They also contain important secondary sources that include interesting topics (not necessarily political) related to the government and these readily supplement the library's general collection in these areas. University of Ife[8] has even gone further by identifying, collecting and preserving government posters in its document department as significant primary source materials.

Purchase is another method of building up Special Collections. Nigerian academic libraries should actively acquire and maintain special collections for the following reasons[14]:

(a) with the advent of nuclear power, there is the need to acquire these materials from all places so as to ensure the preservation of human heritage.

(b) As centres for the study of man and nature, universities should not rely on national libraries and national museums alone but should strive to build their own collections.

(c) Since these materials are of permanent value, university libraries are justified in their acquisition.

(d) A university derives a justifiable sense of pride and of responsibility from the fact that its librarian is the custodian of unique materials which are part of the cultural heritage of an entire nation and indeed of the whole civilized world.

(e) Such materials are very basic for research. Without access to them, scholarship and learning will suffer.

Special collections are not easily available in the open market. Nigerian academic libraries get their supplies either by subscription or by auction sales or by gift. Even though the process of soliciting and organizing a flow of gifts are far less amenable to the development of a systematic method than those of acquisition by purchase and gift. Gift, in many respects, is of more importance than purchase as the history of any large academic collection will show. Gifts come in the form of bequests, presentation of money for the purchase of books in a specific subject area, concealed gift in which the library is given the opportunity to buy a complete collection, or its choice of books at a price considerably lower than the owner knows he could obtain in the open market. Here, the purchase of the Clarence L. Holte Collection of Africa displayed in Lagos at the Second World Black and African Festival of Arts and Culture 1977 by Ahmadu Bello University, Zaria, can be cited as an example, and virtual gift - when owners without surrendering legal ownership of material deposit it in a library and make it generally available for scholarly consultation etc.

To accept a collection as gift, one has to consider whether or not:

(a) the subject is still of interest to the university.
(b) the financial resources available to the library are enough to continue to augment the collection if it must remain alive and useful.
(c) there is sufficient space to accommodate the collection.
(d) there are human resources to sort and calander or index the collection for scholarly acceptability.

ALLOCATION OF FUNDS

Except for the intellectually arrogant and the sceptical relativist, special collections in Nigerian academic libraries need no special pleading. The importance of such materials in research and training are widely discussed in the literature of Library Science. Funds for the development of Special Collections may come from:

(a) Cash gifts
(b) Operating income
(c) Expendable trust funds
(d) Endowments
(e) University fundations
(f) Research and contingency funds

From formula for fund allocation (operating income) depends on the need, the university has for particular books and special collection in general. This is why, in a place like Nigeria where the graph for fund allocation has taken a complete nosedive, the librarian must encourage through subtle publicity the use of his materials so as to be able to justify any request for the increase of allocation. It is instructive that most academic libraries in North America do not budget annually for special collections yet spend so much annually because of the availability of cash gifts, trust funds, endowments, research and contingency funds, fundations, etc.

MANAGEMENT AND PRESERVATION

The unique nature of special collections makes their organization and management more difficult. Manuscripts are fragile and they need special care. The acquisition of rare materials is a painstaking exercise especially in a developing country like Nigeria. Some of the materials need special treatment because of their heavy use. If proper organizational and administrative care is not taken, the special collection will end up in a chaotic state and this will militate against effective utilization as is the case with the special collection department of the University of Ibadan Library.

Once records have been selected for permanent deposits in the special collection of a university, an accession folder should be maintained by the department. All accessions should be recorded in a single line entry in a register of record holdings. The library should go further by publishing bibliographies of its holdings. Historical manuscripts should be placed in document boxes after they are arranged in cataloguable units. Adequate records should be kept to indicate donors and dealers of manuscripts from whom purchase was made.

Conservation and preservation of library materials constitute a very vital aspect in library management. "Acid impurities introduced during paper production since the mid-nineteenth century and assimilated since from air pollutants cause a breakdown of the cellulose molecule and ultimate total deterioration of the paper. Harmful environmental conditions such as heat and humidity extremes, aid in this destruction"[10].

The magnitude of this problem can be appreciated when we realise that most of the total stock of special collections in Nigerian academic libraries are made of woodpulp paper which are very vulnerable to decay. Acid content in books is presumably higher in modern books. Humidity and lighting problems aid rapid deterioration of special collections. The higher the temperature, the faster the deterioration of special collection and Nigeria is a tropical region. The accelerated growth of library holdings continues to put pressure on new methods of preservation. The growth of library holdings is the result of expanding scope of book publishing. Like a chain, this increase in book publishing in Nigeria has led to greater demand in paper and subsequently resulted in the fall of the quality of paper.

It is believed that there are about 1,000 species of insects that can damage library materials apart from 300 species of mild fungi[11]. An academic library acquiring catalogues and storing paper-based and other special materials is of no guarantee that these materials would be preserved for the use of future generation. Means should be devised to prevent their rapid deterioration. A strong and comprehensive preservation programme with the following objectives as recommended by Sylvester[12] are desirable:

(a) The preservation of the intellectual content of deteriorating materials which have permanent research vaule, but which do not warrant the greater expense of physical preservation.

(b) The preservation and restoration of library materials that are valuable beyond the information they contain.

(c) Ensuring the preservation of future library materials through preventive conservation.

Microreproduction is a means of preserving intellectual content. Rare books, books important for their illustrations, book annotated by famous people, music and library manuscripts and catographic materials are all examples of materials that need to be physically preserved. The use of acid-free paper is a means of preserving future library materials. When repairing a book, care must be taken so that nothing is removed or added to the document in the course of repair. Plastic lamination is considered suitable for holding together fragile documents painted in mechanical woodpapers - for instance, newspapers.

Special collections should be housed under conditions of strict security, in stacks to which direct users' access, though seldom completely prohibited, is the exception rather than the rule. Direct access limitation to research materials such as special collections is a security not only from rough handling or theft or mutilation but also in respect of conservation. Books are known to survive better when light is subdued or there is no light at all and at temperatures rather lower than those comfortable for humans. Achievement of these measures is more probable in a closed stack than in open access. It is important that special collections, whether in closed or open access should be protected from direct sunlight and also artificial light should be reduced to barest convenient minimum for direct light has adverse effects on books. Adequately filtered and flourescent lighting is considered better suited for the stacks.

ACCESSIBILITY AND UTILIZATION

The basic and fundamental difference between the general collection and special collection in an academic library is the question of material accessibility. Most general or main collections are on open stacks while almost all special collections are on closed stacks. While the patron can, if conversant with the catalogue in use, gain direct access to materials in the main collection without bothering any of the library staff, the circulation desk is the ultimate key to the special collections.

The question accessibility of special collections, vis-a-vis their utilization, has continued to generate serious debate. Should special collections be on open stacks or closed stacks? Closed access has resulted in under-utilization of special collection apart from de-emphasizing the significance of browsing. Proponents of open access have always drawn attention to the possibility of serendipity. Users should be allowed to roam in the stacks because they are likely to pick up materials of interest. But there is the nagging question of whether a reader is best served by turning him loose in the collection to seek his salvation. What are his chances of finding the right material? Since a high percentage of library users in Nigeria avoid the card catalogue, does direct access to shelves not waste readers, time? Even though special collections need to be properly handled, physically protected and accessibility to these collections be controlled, yet they exist to be utilized. Discouraging their utilization in any form is to turn the special collection into a museum, which is only one part of its functions. While acknowledging the validity of the points in support of open access, it might be unwise to leave access to special collection unrestricted without solving the accompanying problems of theft, mutilation, improper handling, space, disarrangement, etc.

CONCLUSION

Special collections in Nigerian academic libraries are comparatively grossly inadequate. The materials available lack properly coordinated arrangement for the purpose of easy retrieval and utilization. The inability of the major academic libraries in Nigeria to cope with these problems have driven enthusiastic researchers in the humanities and social sciences for instance, to turn to foreign academic institutions with the mistaken belief that no material of their interest exist locally that could aid their research efforts. For these collections to be well-exploited, their existence and location must be known, they must be well-organized and managed for easy retrieval. Academic libraries in Nigeria should strive to encourage rapid development of existing special collections and where there are are none, effort should be made to develop them.

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DISTRIBUTION PATTERN OF PUBLICATIONS OF THE ANIMAL SCIENTISTS (including FISHERIES) OF THE UNIVERSITY OF AGRICULTURAL SCIENCES, BANGALORE

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Publication lists from the annual reports of the University of Agricultural Sciences, Bangalore for the years 1980-81 to 1983-84 were analysed to determine the distribution pattern of scientific publications of the animal scientists (including fisheries) of the UAS. The analysis revealed that the contributions have largely appeared elsewhere rather than in the domestic journal, Mysore Journal of Agricultural Sciences.

INTRODUCTION

Encyclopaedia Britannica defines agricultural sciences as dealing with the aims and problems of farm production, including soil cultivation, crop growing and harvesting, animal husbandry, and to some extent, the processing of plant and animal products to a marketable stage [1].

The base for productive and prosperous agriculture in any country is research. The phenomenal progress recorded in agricultural production in the developed countries is a direct result of the systematic research work that has been done in the higher institutions of agricultural learning, in the respective countries. Agricultural education, research or service organisations can be effective only when they are dynamic, organically integral part of the agricultural process of the country in question. There is also a new awareness that the fruits of the university research and development activity have little economic value unless they are systematically harvested in the market place.

THE UNIVERSITY OF AGRICULTURAL SCIENCES, BANGALORE

The University of Agricultural Sciences (UAS) started functioning from October 1, 1965 with the transfer of the College of Agriculture at Hebbal and Dharwar, the Veterinary College at Hebbal, and 34 research stations spread over the Karnataka state from the state government. Later, the Marine Products Processing Training Center at Mangalore was also transferred. This center formed the nucleus for the College of Fisheries established in 1969 at Mangalore, to provide degree level training in fisheries. The Agricultural Engineering Institute was established in the same year at Raichur, to impart diploma lavel education in agricultural engineering. A Home Science College was started in 1974 at the Dharwar Campus for a rural-biased home science education for women.

With the basic philosophy of the UAS being integration of teaching, research and extension programmes, besides research scientists, there is an active involvement of teachers and postgraduate students also in the research projects of the university, contributing to positive improvement in research output.

In the fulfilment of its objective of promotion of agriculture through dissemination of latest knowledge of practical value, the UAS embarked on a systematic publication programme right from its inception in 1965. A Publications Division was organised to promote publication and dissemination of information in the triple aspects of agricultural improvement work, viz., teaching, research and extension. Three periodicals being published by the UAS are:

1. *Mysore Journal of Agricultural Sciences (MJAS), a* major primary channel of research communication, published quarterly since 1967;
2. *Current Research,* a fortnightly, published since 1972. Besides a feature article,

contains research news of interest to extension workers, and short communications;

3. *Krishi Vijnana,* is a landmark in the publication activity of the UAS. It is a Kannada quarterly meant to enlighten farmers, extension personnel and general public, on the principles underlying new agricultural technology, so as to inculcate in item the habit of scientific thinking about their agricultural practices and programmes.

In addition, there are several non-serial publications in English and Kannada being issued from time to time [3].

WHY SCIENTISTS WRITE

Scientific communication includes full spectrum of activities associated with the production, dissemination and use of information from the time a scientist gets the idea for his research until the information about the results of this research is accepted as a constituent of scientific knowledge. Communicability has become a salient feature of a scientific product, since its recognition by the peers as a unique contribution is essential in establishing a scientist's success in science. The scientists of the UAS are no exception to this.

SCOPE

In this paper an attempt has been made to find out how the research information originating from the animal laboratories and fish ponds of the UAS are finding an outlet into the scientific world at large, and which are these channels.

MATERIAL FOR ANALYSIS

The data for the present study is collected from the annual reports of the UAS for the years from 1980-81 to 1983-84. Each annual report contains a faculty-wise list of publications of the UAS scientists published during the year under review. Table 1 gives the details of such publications from 1980-81 to 1983-84.

Table 1: Year-wise and discipline-wise distribution of papers

Discipline	1980-81	1981-82	1982-83	1983-84	Total
Anatomy	-	-	-	1	1
Anim. Genet. Breed	8	18	4	8	38
Anim. Nutr.	2	-	16	8	26
Aquat. Biol	-	-	3	-	3
Aquaculture	15	8	3	5	31
Fish. Biol.	-	-	2	3	5
Fish. Microbiol.	-	-	4	-	4
Fish. Oceanogr.	-	-	2	-	2
Hydrography	4	-	-	-	4
Inland Fish	6	-	-	3	9
Obstet. Gynecol.	5	-	-	4	9
Parasitology	9	-	10	5	24
Pharmacology	5	-	-	10	15
Physiology	-	-	-	2	2
Surgery	-	-	-	3	3
Total:	54	26	44	52	176

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ANALYSIS

Authorship pattern

A total of 176 papers have been published by the animal scientists of the UAS during the years from 1980-81 to 1983-84. Table 2 shows the authorship pattern of these publications.

Table 2: Authorship pattern

Authors	No. of papers
Single author	47
Two authors	90
Three authors	28
More than three authors	11

Veterinary sciences and fisheries being applied sciences involve many other associated disciplines and require a team work. The concept of independent and isolated research does not seem to have much value in the present day. This is evidenced in the present study also. The author-wise analysis shows that only 47 papers are by individual authors whereas 129 papers are joining ventures.

Bibliographic forms of communication channels

176 papers have been published in 65 serial and non-serial publications. Table 3 shows the distribution of papers according to different bibliographic forms.

Table 3: Bibliographic forms of documents

Bibl. Forms	Nos.	No. of papers
Periodicals	35	121
Proceedings of Conf., Congr., Symp., Seminars etc.	18	39
Others	12	16

From Table 3 it is clear that the major channel of communication is the scientific periodical accounting for 53.9%. Proceedings of the conferences, congresses, symposia and seminars, etc., form the second highest group (27.7%) followed by non-serial, miscellaneous publications like souvenirs, miscellany etc. (18.4%).

Periodical publications

Table 4 gives the year-wise distribution of papers published in each of the 35 journals.

Table 4: Journal and Year-wise distribution of papers

Sl. No	Journal	1979	1980	1981	1982	1983	1984	Total
1.	Acarol. Newsl.	-	-	-	-	-	1	1
2.	Agric. Wastes	-	1	-	-	-	-	1
3.	Aquaculture	-	1	-	-	-	-	1
4.	Centaur	-	-	-	-	-	1	1
5.	Curr. Res.	-	5	1	-	-	-	6
6.	Curr. Sci	-	-	-	-	-	1	1
7.	Dairy Guide	-	1	-	-	2	-	3
8.	Experientia	-	-	-	-	-	1	1

DISTRIBUTION PATTERN OF PUBLICATIONS

1	2	3	4	5	6	7	8	9
9.	Fmr. J.	-	-	-	1	-	-	1
10.	Fishing Chimes	-	-	-	-	-	1	1
11.	Indian Fmg.	-	-	1	-	-	-	1
12.	Indian J. Acarol.	-	-	-	1	1	-	2
13.	Indian J. Anim. Rep.	-	-	-	-	1	5	6
14.	Indian J. Anim. Sci.	-	-	-	2	-	-	2
15.	Indian J. Fish.	-	-	-	1	-	-	1
16.	Indian J. Mar. Sci.	1	-	-	2	2	-	5
17.	Indian J. Pharmacol.	-	2	-	-	-	-	2
18.	Indian Vet. J.	-	4	1	2	3	2	12
19.	Janapriya Vijnana	-	2	-	-	-	-	2
20.	J. Indl. Fish. Soc. India	-	2	-	-	-	-	2
21.	J. Mar. Biol. Ass. India	-	-	-	2	-	-	2
22.	J. Phar. Med. Sci	1	-	-	-	-	-	1
23.	Kerala J. Vet. Sci.	-	-	-	-	1	2	3
24.	Krishi Varthe	-	-	-	-	1	-	1
25.	Livestock Adviser	-	4	6	5	4	-	19
26.	Mahasagar - Bull. Nat. Inst. Oceanogr.	-	1	-	-	-	-	1
27.	Milcow	-	-	-	1	2	-	3
28.	Mysore J. Agric. Sci.	-	13	8	-	1	-	22
29.	Mysore Vyavasaya Patrika	-	1	-	-	-	-	1
30.	Poultry Adviser	-	-	-	1	-	-	1
31.	Poultry Guide	-	-	-	-	2	-	2
32.	Proc. Indian Acad. Sci.	-	1	1	-	-	-	2
33.	Seafd. Export J.	-	-	-	-	-	1	1
34.	Shipping & Mar. Indust. J.	-	1	-	-	-	-	1
35.	Veterinarian	-	1	1	1	2	4	9
	Total	2	39	20	19	22	19	121

Foreign vs India journals

Of the 35 journals only 5 are foreign journals with 5 papers. Remaining 30 Indian journals cover the rest of 116 papers. This shows that majority of the scientists prefer Indian journals to publish their papers. This may be due to-

- cost involved in the preparation of manuscripts for foreign journals;
- compulsory membership requirement from the author/s;
- page charges;
- postage involved in foreign correspondence.

These prerequisites are not rigidly observed by the Indian journals [2].

Ranking of journals

Table 5 gives a ranked list of journals according to the number of papers published.

Table 5: Ranked list of journals

S. No.	Rank	Journal	No. of papers
1	1	Mysore J. Agric. Sci	22
2	2	Livestock Adviser	19
3	3	Indian Vet. J.	12
4	4	Veterinarian	9
5	5	Curr. Res.	6
6	5	Indian J. Anim. Rep.	6
7	6	Indian J. Mar. Sci	5
8	7	Dairy Guide	3
9	7	Kerala J. Vet Sci.	3
10	7	Milcow	3
11	8	Indian J. Acarol	2
12	8	Indian J. Anim. Sci.	2
13	8	Indian J. Pharmocol.	2
14	8	Janapriya Vijnana	2
15	8	J. Inld. Fish. Soc. India	2
16	8	J. Mar. Biol. Ass. India	2
17.	8	Poultry Guide	2
18.	8	Proc. Indian Acad. Sci.	2
19.	9	17 journals	1 each

All journals with at least two papers are listed in Table 5. Journals with only one paper are given at the end as a single group in order to avoid unduly long list.

Of the 121 papers, *Mysore Journal of Agricultural Sciences* tops the list with 22 papers (18.1%) followed by *Livestock Adviser* with 19 papers (15.7%) and *Indian Veterinary Journal* with 12 papers (9.9%).

Productivity of journals

In order to measure the productivity of these 35 journals, the 121 papers were divided into three groups of 40 papers each. The number of journals under each group is given in Table 6.

Table 6: Productivity of journals

S.No.	No. of papers	No. of Jrl.	Average
1	41	2	20.5
2	41	6	6.83
3	39	27	1.44

It is observed from Table 6 that the first group of 41 papers are published in only two journals, signifying their high rate of productivity. The second group of 41 papers have appeared in 6 journals while the third group of 39 papers are scattered through 27 journals. The average productivity of each journal in the first group is 20.5 papers whereas it has decreased considerably to 1.44 in the third group.

Publication pattern in MJAS

The MJAS publishes papers under four heads, viz., Plant Sciences, Animal Sciences, Fisheries Sciences and Social Sciences. Table 7 gives the details of the publication pattern of MJAS from 1980 to 1984.

The publication pattern shows that the plant sciences are given more importance over the animal sciences in the MJAS. In the present study it is in the ratio of 6:2:1.

DISTRIBUTION PATTERN OF PUBLICATIONS

Table 7: Paper distribution pattern in MJAS

Year	Vol.	Nos.	No. of papers Pl. Sci	 Anim. Sci. (Incl. Fish Sci.)	 Soc. Sci	Total
1980	14	1-4	64	26	9	99
1981	15	1-4	57	26	13	96
1982	16	1-4	52	13	9	74
1983	17	1-4	45	13	7	65
1984	18	1-3	26	7	4	37
	Total		244	85	42	371

Table 8: Distribution of animal science papers in MJAS

Year	Vol.	Nos	UAS Original	 Based on theses	Non-UAS	Total
1980	14	1-4	14	12	-	26
1981	15	1-4	15	9	2	26
1982	16	1-4	3	4	6	13
1983	17	1-4	5	8	-	13
1984	18	1-3	3	3	1	7
Total			40	36	9	85

MJAS vs Animal Reports

The present study reveals that out of 121 journal papers listed in the UAS annual reports only 28 papers are found in the two of the UAS journals i.e., *MJAS* with 22 papers and *Current Research* with 6 papers. The remaining 93 papers are published elsewhere.

It is of interest to note that the number of papers published in the MJAS do not correlate with the number of papers listed in the annual reports as could be seen from Table 8.

The annual reports from 1980 to 1984 listed only 22 papers as published in MJAS whereas actual analysis of MJAS of the same period yielded 76 papers of which 36 were based on the theses of the authors.

CONCLUSION

Since the annual report is an official document depicting the productivity and growth of an organisation, it is desirable that the editorial office of the MJAS takes cognisance of this disparity. However, because of the lesser coverage given to the animal sciences in MJAS, an undesirable consequence is seen. The results of the scientific research carried out in the UAS are mostly published elsewhere, and are more accessible to the scientists who have access to these journals than they are within the university. A kind of intellectual migration is observed. Or, could this be termed as "manuscript drain?"

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AGE OF LITERATURE STUDIES IN AGRICULTURAL ECONOMICS

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6869 citations received by the American Journal of Agricultural Economics and Indian Journal of Agricultural Economics during 1970 to 1980 have been analysed and half life of the literature determined from American and Indian point of view, through citation analysis. Results show that book literature decays faster than journal literature.

INTRODUCTION

The use of literature of a particular discipline reaches a maximum after a certain period of time from their date of publication and there its use gradually decreases. Many scientists have tried to measure the relationship between the time (age of the literature) and the amount of literature that cease to be used. This type of relationship is usually expressed by the term 'obsolescence'. Enormous literature have been published on obsolescence, but there is no clear cut definition of it. However Line and Sandison [3] said that if something is less and less used it is said to 'obsolesce' and when its use ceases it is 'obsolete'. So obsolescence of literature implies two things: the amount of documents used and the time that has passed, calculating from the moment a document is published and used - the use of information in past. Also some scientists have used the concept 'half life' of the literature [4]. It is the period of time during which half of currently cited literature is published.

Keeping this in mind a measure of obsolescence of literature in agricultural economics has been attempted through citation analysis. This method gives no idea about the identification of the document which becomes obsolete, it only predicts that certain portion of the literature becomes obsolete as time passed. It should be borne in mind that obsolescence is characterised as a reduction in the citing of a written knowledge with time. A decrease in the citing of a document does not imply a decrease in the value of the information that it contains, only it is not cited.

There are a good number of cases where citation analysis has been applied to indicate the age of literature of a particular discipline. Some of the important ones are Earle and Vickery in social sciences [1], Line in anthropology, criminology, environmental planning and political science [2], Xhinesse and Osgood in psychology [5]. The scope of the present paper lies in analysing the citations appended to the research papers in agricultural economics contributed by American and Indian authors, with a view to finding out the distribution of citations in different age groups.

METHODOLOGY

Citations that appeared in the form of reference and footnotes have been collected from the articles published in the *American Journal of Agricultural Economics(AJAE)* and *Indian Journal of Agricultural Economics* (IJAE) between 1970 and 1980 (both years inclusive). The differences in the years of publications of the citing and the cited documents have been taken as the relevant age of the particular citation. If both the citing and the cited documents happened to fall in the same year, the difference was noted as zero. After recording the relevant ages of all the citations in slips, they were then tabulated for observations.

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* *Related article by the author appeared in Annals Sep-Dec 1985, Vol. 32 (3-4), p.93-98*

OBSERVATION AND DISCUSSIONS

The total number of citations recorded were 6869 out of which 3793 (i.e. 55.21%) belonged to journal citations and 3076 (i.e. 44.78%) belonged to book citations. If should be emphasized at this stage that the major portions of the contributions in both the journals were by the authors belonging to their own nationality, i.e. American in *AJAE* and Indian in *IJAE*. Only 32 contributions out of 296 (i.e. 10.8%) in *AJAE* and 30 contributions out of 192 (i.e. 15.6%) in *IJAE* were by authors of foreign origin. This clarifies that the age of citations appended to the contributions of *AJAE* would reflect the mind of American authors whereas that of *IJAE* would reflect the mind of Indian authors. While calculating the years of difference to all the citations, it was found that, journal citations in *AJAE* ranged from 'O' (zero) year to 63 years whereas those in *IJAE* ranged from 0 (zero) year to 56 years and book citations in *AJAE* ranged from 0 (zero) year to 156 years whereas those in *IJAE* ranged from 0 (zero) year to 51 years. However. it was found that very few citations in both the journals exceed 30 years of difference. Taking this as an advantage, the whole range of years have been divided into groups such as 0,1,2,3,4,...,19,20, 21-25, 26-30, 31 and above.

Distribution of citations in different age groups.

Analysis of the number, percentage and cumulative percentage of journal and book citations in each year interval shows that (Table 1) the maximum percentage of journal citations used by agricultural economists are of 2 years of age, and those of book citations are of one year of age. 50% of journal citations used by agricultural economists were within 0-5 years and that of book citations were slightly over 0-4 years. To cover 75% journal citations it required 0-10 years and that of book citations required 0-9 years.

It can also be noticed from the Table that as the year difference increased, the percentages of the total number of journal citations increased reaching a maximum at year difference 2 and then its use gradually decreased suggesting that information published in journals was heavily used after two years from its date of publication, and as the age of the information increases its relative use gradually decreases. On the other hand, information published in books was heavily used after one year of its publication and then as the age of information increases its use also decreases. In this case the half-life for journal literature is five years and that of for book literature is slightly over four years but less than five years.

Journalwise distribution of citations in different age groups

Analysis of the journalwise distribution of the percentage of citations in different age groups shows (Table 2) that the maximum number of journal citations belonged to the age group 0-2 years and that of book citations 0-1 years, when considered from American point of view. This remains the same when considered from Indian point of view. 50% of journal citations used by American and Indian authors were 0-5 years of age, that of book citations were 0-4 years of age. 75% of journal and book citations used by American authors belonged to age groups respectively of 0-10 years and 0-9 years, and that of by Indian authors belonged to the age groups respectively of 0-9 years and 0-8 years. On the other hand, 90% of journal and book citations used by American authors belonged to the age groups respectively of 0-17 years and 0-16 years and that of by Indian authors belonged to the age groups respectively of 0-15 years and 0-14 years. A close look into the Table 2 shows that book literature decays faster than journal literature. It can also be noticed that upto the level of 50% of journal and book citations, both American and Indian authors show same tendency, but at the level of 75% and 90% of journal and book citations, Indian authors used more current literature than their American counterparts.

Periodwise distribution of citations in different age groups

Periodwise distribution of citations against different age groups shows (Table 3) that maximum percentage of citations belonged to the age group of 0-2 years for both the years 1970

AGE OF LITERATURE

Table 1: Distribution of citations in different age groups

Age groups	Journal citations			Book citations		
	No.	%	cumulative %	No	%	cumulative %
0	173	4.56	-	164	5.33	-
1	339	8.93	13.49	360	11.70	17.03
2	491	12.94	26.43	354	11.50	28.53
3	370	9.75	36.18	331	10.76	39.29
4	297	7.83	44.01	285	9.26	48.55
5	264	6.96	50.97	219	7.11	55.66
6	239	6.30	57.27	180	5.85	61.51
7	224	5.90	63.17	158	5.13	66.64
8	210	5.53	68.70	158	5.13	71.77
9	182	4.79	73.49	150	4.87	76.64
10	130	3.42	76.91	104	3.38	80.02
11	133	3.50	80.41	78	2.53	82.55
12	99	2.61	83.02	60	1.95	84.50
13	70	1.84	84.86	63	2.04	86.54
14	77	2.03	86.89	46	1.49	88.03
15	63	1.66	88.55	42	1.36	89.39
16	49	1.29	89.84	39	1.26	90.65
17	46	1.21	91.05	37	1.20	91.85
18	43	1.13	92.18	30	0.97	92.82
19	45	1.18	93.36	31	1.00	93.82
20	41	1.08	94.44	23	0.74	94.56
21-25	110	2.90	97.34	72	2.34	96.90
26-30	49	1.29	98.63	31	1.00	97.90
31 and above	49	1.29	99.92	51	1.65	99.55

Table 2: Coverage in years of maximum percentage, 50%, 75% and 90% of citations in AJAE and IJAE

Form	Maximum %	50%	75%	90%
AJAE Journals	0-2	0-5	0-10	0-17
IJAE Journals	0-2	0-5	0-9	0-15
AJAE Books	0-1	0-4	0-9	0-16
IJAE Books	0-1	0-4	0-8	0-14

Table 3: Coverage in years of maximum percentage, 50%, 75% and 90% of citations in 1970 and 1980.

Form	Year	Maximum	50%	75%	90%
Journals	1970	0-2	0-4	<0-8	0-11
Journals	1980	0-2	0-5	0-10	0-18
Books	1970	0-1	<0-4	0-7	0-12
Books	1980	0-2	0-4	0-9	0-16

and 1980, and that of book citations belonged to the age group of 0-1 years for the period 1970 and 0-2 years for the period 1980. 50% of the cited journal literature for the period 1970 and 1980 belonged respectively to the age groups of 0-4 years and 0-5 years and that of cited book literature belonged respectively to the age groups of slightly over 0-3 years and 0-4 years. 75% of the cited journal literature for the period of 1970 and 1980 belonged respectively to the age groups of slightly over 0-7 years and 0-10 years, and that of cited book literature belonged respectively to the age groups of 0-7 years and 0-9 years. And lastly 90% of the cited journal literature for the period 1970 and 1980 belonged respectively to the age groups of 0-11 years and 0-18 years and that of for book literature belonged to the age groups of 0-12 years and 0-16 years. The above analysis clearly indicates that there is a tendency to use older literature for the period 1980 than that of 1970. It also shows that book literature decays faster than journal literature.

CONCLUSIONS

As seen from the above analysis, book literature decays faster than journal literature in the field of agricultural economics. Line [2] has reported that in anthropology, criminology, environmental planning and political science journal references decay much faster than book references. Periodwise age distribution shows the tendency of using older literature for the period 1980 compared to 1970. Periodwise age distribution has also been reported in other disciplines by different workers. Xhignese and Osgood [5] showed that only 35% of the citations in 21 psychological journals published in 1960 were to materials more than 10 years old. The 1901 to 1940 period accounted for 38% of citations in 1950 and this figure fall to 12% in 1960.

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LITERATURE CONTRIBUTION IN JOURNAL OF ENVIRONMENTAL BIOLOGY: A BIBLIOMETRIC STUDY

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Analyses the literature contributed (132 items) to the Journal of Environmental Biology, 1980-84 with regard to the nature and the time lag of the citing research papers. It also analyses country-wise and institution-wise scattering of the contributions. The authorship and citation patterns are also evaluated to ascertain the nature of research (solo/team) and the core journals of the discipline. Gives a list of 21 highly cited journals, cited at least 10 times. The Bradford's Law of Scattering is applied to the literature of environmental biology.

INTRODUCTION

The credit for coining the term *bibliometrics* which describes all studies seeking to quantify the process of written communication goes to Pritchard. He defined bibliometrics as "the application of mathematical model to book and other media of communication."[1] The application of bibliometric techniques has gained the importance and recognition in the field of scientific literature. For the last two decades, a number of bibliometric studies have appeared in various scientific disciplines. Hjerppe[2] has compiled a bibliography on the subject, listing more than 1800 studies. In the context of Indian journals, attempts have been made to carry on bibliometric studies for the periodicals like, *Journal of Geological Society of India, Indian Journal of Plant Physiology, Indian Phytopathology, Journal of Indian Chemical Society, Indian Journal of Chemistry, and Indian Journal of Physics.[3-8]*

The *McGraw Hill Dictionary of Scientific and Technical Terms*[9] describes the environmental biology as synonymous to ecology. The subject, environmental biology in itself is multidisciplinary in nature, covering a number of subjects like pollution, ecology, toxicology and allied subjects.

In the present study, an attempt has been made to analyse the patterns of research contribution in the periodical entitled *Journal of Environmental Biology* (JEB). Such analysis will be helpful to the concerned users and contributors to recognise the information needs, requirements and national network of research planning in this discipline. The main purpose of the study is to find out the core journals, most frequently cited by the environmental biologists and also to gain information on:

(i) other types of documents cited by them,

(ii) the authorship patterns of contributions

(iii) the scattering of the literature in the subject,

(iv) institutes engaged in the research of environmental biology in the country, and

(v) use of journals in the languages other than English.

MATERIALS & METHODS

As mentioned earlier, the *Journal of Environmental Biology* has been selected for this study. It is a publication of the Academy of Environmental Biology, India. The journal is concerned with toxicology and interrelations of organisms and their environment. *JEB* publishes original research papers in English language, primarily dealing with the aspects of environmental pollution in relation to men, animals and plants. The Academy of Environmental Biology, India was established in 1978 and started to publish the journal in 1980. The journal is published quarterly in January, April, July and October. Owing to its wide circulation and being a recently started journal covering the literature of the burning topics like pollution, toxicology, etc. and also publishing the original research papers on these subjects, the journal has been selected. Some other factors that influenced the selection of this particular journal are (i) it is a regular publication of a learned academy of the country, and (ii) it is also being covered by a number of national and international indexing and abstracting services.

All the sixteen issues of the volumes 2-5 (1981-84) and one issue published in October 1980 as Vol. 1; issue 1 were scanned in the original. The information regarding the bibliographical descriptions of the research papers and references quoted to write these research papers, were recorded on the 5"x8" slips. The problem of identification of journal titles were solved by using the *Ulrich's International Periodicals Directory, Irregular Serials* and *CASSI;* regarding the abbreviations, help of the *World List of Scientific Periodicals* was taken.

RESULTS & DISCUSSION

Nature of the Contributions

A volume-wise analysis of the citing literature, i.e., research papers is presented in the Table 1. The total number of citing research papers of the *JEB* published in the seventeen issues of the journal came to 132 of which 113 (83.6%) are main research papers and 19(14.4%) are short communications.

Among the contributions of the *JEB,* the average ratio of the main research papers and the short communications is observed to be 6:1 and the same pattern is followed by the *Indian Journal of Plant Physiology.*[4] However, the analysis of the data reveals that the trend of publication of *JEB* is less inclined towards the short communications.

Geographical Distribution of the Contributors

267 scientists contributed 132 research papers published in the *JEB.* The contribution is predominantly made by the Indian scientists to journals. Among 267 contributors, 19 are foreign scientists who have contributed 12 papers (main research papers) which consti-

Table 1: Volume-wise Analysis of contributions

Year	Volume No.	No. of Issues	No. of Main Res. Papers	No. of Short Communications	Total	%
1980	1	1	7	1	8	6.07
1981	2	4	22	3	25	18.94
1982	3	4	23	3	26	19.69
1983	4	4	28	5	33	25.00
1984	5	4	33	7	40	30.30
Total	5	17	113	19	132	100.00

tute 9.09 % contributions of the JEB. In another study. the foreign scientists' contribution in Indian primary periodicals was recorded as 5.4%.[10] Thus, it is seen that *JEB* is publishing more contributions of the foreign scientists.

Of these 12 papers contributed by the foreign scientists, 7 are from U.S.A. and one each from U.K., Sweden, West Indies, Romania and Nepal. It is observed here that most of the foreign contributions are from advanced countries. Of the 12 papers contributed by the foreign scientists, 8 papers are wholly prepared by the foreign scientists (independently or jointly) and remaining four papers are prepared in collaboration with the Indian scientists. A detailed analysis is presented in Table 2.

Authorship Pattern

As the data reveals, team research is the trend of the present day and is dominant over solo research in the experimental sciences. The number of contributors for a paper even in the *Journal of American Chemical Society* [11] is as high as eight. Out of the 132 research papers, only 14 (10.61%)are single authored and the remaining 118 (89.39%) are contributed by two and more than two authors. More than 70% papers have been contributed by two and three authors.

Table 4 shows that most of the research papers are from universities, colleges and research labs/institutes which are engaged to provide M. Phil. /Ph.D. degrees under the guidance of the supervisors. Generally, the research papers are the products of theses submitted for the degree, and are published under the joint authorship of the supervisor(s) and the research scholar(s). Majority of foreign contributions are from U.S.A. (58.33%). Out of 12 papers from foreign scientists, three are single authored one each from U.S.A., U.K. and Romania and remaining 9 papers are of joint authorship, of which six from U.S.A.

Table 2: Distribution of the Contributors

Volume	Number of papers by Indian Contri-Contributors	Number of papers by Foreign Contributors	Number of papers by Indian & Foreign Contributors	Remarks
1	6	2	-	
2	23[a]	2[b]	-	
3	23[c]	2[d]	1	First author is Indian
4	33[e]	-	-	
5	35[f]	2[g]	3	First author of three papers are foreigners

Note:

a = Three papers are from two different institutes.

b = One paper is from two different institutions.

c = Two papers are from two institutes and one paper is from three different institutes.

d = One paper is from two different institutes.

e = Four papers are from two institutes and only one paper is from three different institutes.

f = Three papers are from two different institutes.

g = Two papers are from two different institutes.

Table 3: Authorship Pattern of Contributions

No. of author(s) contributing a paper	No. of Main Res. papers	No. of Short communications	Total No. of papers	%
1	14	-	14	10.61
2	50	12	62	46.97
3	29	4	33	25.00
4	12	2	14	10.61
5	5	-	5	3.73
6	2	1	3	2.27
8	1	-	1	0.76
TOTAL	113	19	132	100.00

Table 4: Institution-wise Distribution of Contributions

S.No.	Organisation	No. of Contributing organisations	No. of papers contributed	%
1	Universities	32	73	55.30
2.	Colleges	14	30	22.72
3.	Research Labs/ Institutions	12	23	17.43
4.	Miscellaneous	5	6	4.55
	Total	63	132	100.00

(two having two authors; another two papers having six authors, and the remaining two papers having 3 and 4 authors) and one paper each from Sweden, Nepal and West Indies having 2,2 and 3 authors respectively.

There are only two scientists (S.R. Verma from Zoology Department of D.A.V. College, Muzzaffarnagar and R. Nagabhushanam, from Zoology Department, Marathwada University, Aurangabad) who have contributed to the journal maximum, i.e. five times. Three authors contributed four times and. 6, 49, and 207 authors have contributed thrice, twice and once respectively. This indicates that there is a visible scattering among the contributors.

Institution-wise Distribution of Contributions

The contribution to the journal (JEB) is coming from all over the country and it is also quite rich in respect of foreign contributions. As the data reveal, there is also diversity among the contributors of various organisations, indicating that the journal is well-recognised throughout the world. There are twenty papers which are contributed by two different organisations and two papers by the contributors of three organisations, and remaining are from single organisation.

Here, the organisation of the first author is considered for the institution-wise distribution of the contributors. Table 4 shows that a significant proportion of the contribution i.e. 55.30% has come from 32 universities, 22.72% from 14 colleges affiliated to the universities, and 17.43% from 12 research labs/institutions. The remaining 4.55% contributions have come from a category of 5 miscellaneous organisations. The main contributing organisations to the journal which have contributed 3 and more than 3 papers are given in the Table 5.

Time Lag in Publishing

The information regarding the date of receipt and acceptance for the publication is not mentioned in nine papers (8 papers from Vol 1, issue 1 and one paper from Vol 3, issue 3). For the remaining 123 papers, the average time taken for their publication is seven months, with the minimum and maximum time for the publication recorded being 25 days and 2 years & 1 ½ months respectively. The 107 (87%) research papers were accepted in a period of less than a year and remaining 16(13%) papers except only one paper, had taken the time 1-2 years for the acceptance. The time taken for publication after the acceptance of the research paper is recorded upto 19 months. This time lag is critical, as most of the literature is of ephemeral type, i.e., short lived, and this delay in publishing the research papers should be avoided.

Citation Pattern

The degree of sharing or transferring information and communication network established for a growing discipline can be analysed through the citation patterns in the writings of that discipline. [13] The citation pattern also depicts diverse media for communication of scientific research [14]. 132 research papers under study indicate that 1800 documents have been cited with an average of 14.4 citations per paper. But the citation rate of the main research papers is double in comparison to short communications (Table 6).

Table 5: Institution Contributing three and more than three papers

S.No.	Name of the Organisation	No. of papers contributed
1.	D.A.V. College, Muzaffarnagar	12
2.	Marathwada University, Aurangabad	10
3.	Sri Venkateshwara University, Tirupati	8
4.	Industrial Toxicology Research Centre, Lucknow	8
5.	Punjab Agricultural University, Ludhiana	5
6.	Berhampur University, Berhampur	4
7.	Rajasthan University, Jaipur	4
8.	Andhra University, Waltair	4
9.	Vikram University, Ujjain	3
10.	Meerut University, Meerut	3

Table 6: Citation Pattern of the Research Papers

Main Res. Papers	Citations appended to Main Res. Papers	Average	Short Communications	Citations Appended to Short Communications	Average
113	1661	14.7	19	139	7.3

The citation ratio of journals to books is 4 : 1. This shows that journals are the main vehicles for the communication of scientific research.

A lot of literature, about 55%[15] in science and technology is being published in the languages other than English have been noted here due to the non-availability of such literature, and also because of the language barrier. Some of the non-English cited journals are *Biokhimiya* (Russian), *Botanicheskii Zhurnal* (Russian), *Biologisches Zentralblatt (German), Munchener Medizinisch Wocheschriff* (Spanish), *Vigyan Parishad Anusandhan Patrika* (Hindi), *Rybnoe Khozyaistvo* (Russian) *Hikobia* (Japanese), etc.

Bibliographical Forms of the Cited Documents

One of the objectives of this study was to find out the different bibliographical forms of the cited literature. The analysis of the same data reveals that 71.78% of the total citations are from journals, 17.56% from books, and the remaining 10.66% cited documents are of various bibliographical forms such as proceedings (conferences, seminars, symposia and workshops etc.), reports (technical, projects, official, government and annual), theses (Ph.D., M.V. Sc.) and others. The 'others' category meets a fraction, i.e., 0.94% of the information needs of the scientists of the subject, and includes monograph, newsletters, encyclopaedias, treatises, standards, patents and atlases, etc.

From this, it is clear that about 90% of the information needs of the environmental biologists are met by journals and books.

Bradford's Law of Scattering of Literature of JEB

The graphical and verbal interpretation of the Bradford's law of scattering is being applied to the literature of JEB. Table 8 represents the journals arranged in decreasing frequency of citations.

The 472 journals which have been referred to in the *JEB* (1980-84) yielded 1292 citations. To testify the applicability of Bradford's law of scattering, a graph is plotted by taking the cumulative number of citations R(n) on the ordinate against the logarithm of cumulative number of journals log (n) on the abscissa. It is observed that the resulting bibliograph, initially starts with the rising as in exponential nature and than follows into a linear curve, indicating the observance of Bradford's law of scattering.

Here, it is observed that an experimental curve (continuous line) is closely associated with theoretical curve (dotted line). (Fig.1).

If Bradford's law is applicable to the data of the *JEB* literature, it would also follow the algebric interpretation of the Bradford's law of scattering. For the algebric interpretation of the law, the citations have been arranged into three zones with 431 citations each.

The scatter of *JEB* literature over Bradford's zones following the De Queriroz and Lancaster, [16] is given in Table 9. The Bradford multiplier factor is calculated with the ratio of journal titles of a zone and its succeeding zone, as 3.5 and 3.6 for the zone 2 and zone

Table 7: Distribution of Citations based on the Bibliographical Forms

S.No.	Form of the Document	Citations	Percentage	Cumulative Percentage
1.	Journals	1292	71.78	71.78
2.	Books	316	17.18	89.34
3.	Proceedings	106	5.89	95.23
4.	Reports	42	2.33	97.56
5.	Theses	27	1.50	99.06
6.	Others	17	0.94	100.00

Table 8: Distribution of Cited Journals by Decreasing Frequency of Citations, JEB, 1980-84

No. of Journals	Cumulative No. of Journals	Log. of Cumulative No. of Journals	No. of Citations	Total No. of Citations	Cumulative No. of Citations	% of Cumulative Citations	% of Cumulative Journals
1	1	0.00	47	47	47	3.63	0.21
2	3	0.48	29	58	105	8.04	0.63
1	4	0.60	26	26	131	10.15	0.84
1	5	0.70	25	25	156	12.07	1.05
1	6	0.78	24	24	180	15.47	1.26
2	8	0.90	20	40	220	17.02	1.67
1	9	0.95	17	17	237	18.26	1.90
1	10	1.00	15	15	252	19.50	2.11
2	12	1.08	14	28	280	21.67	2.54
1	13	1.11	13	13	293	22.68	2.75
3	16	1.20	12	36	329	25.46	3.36
2	18	1.26	11	22	351	27.16	3.81
3	21	1.32	10	30	381	29.48	4.45
6	27	1.43	9	54	435	34.44	5.72
5	32	1.51	8	40	475	36.76	6.78
11	43	1.63	7	77	552	42.72	9.11
9	52	1.71	6	54	606	46.90	11.22
15	67	1.83	5	75	681	52.71	14.19
20	87	1.94	4	80	761	58.81	18.43
35	122	2.05	3	105	866	67.01	25.84
76	198	2.30	2	152	1018	78.71	41.95
274	472	2.67	1	274	1292	100.00	100.00

Table 9: Scattering of the citations in the Bradford zones

Zone	Citations	Journals	Percentage of journals	percentage of citations	Bradford Multiplier Factor
1	435	27	5.72	33.66	-
2	431	95	20.12	33.36	3.5
3	426	350	74.16	32.98	3.6
Total	1292	472	100.00	100.00	-

3 respectively. It is almost the same. Thus, an approximately geometric series is represented by the data of the *JEB* literature.

Core Journal

The analysis of citations is valuable in identifying the core journals in a particular field/discipline. The sources of most frequent citations in a journal provide an indication of the intra-journal communication network associated with the particular discipline or journal and thus can give valuable clues to the transfer and sharing of information within and between disciplines[12]. A total of 1292 journal citations belonging to 472 primary journals shows the scattering of the subject literature into various disciplines. A list of 21 most productive journals of the Bradford's core zone accounted for 29.48% of the total ditations. (Table 10).

Table 10: List of More Productive Journals of the Core Zone

S.No.	Rank	Journal Title	Year of Origin	Country	No. of citations	**% of citations
1.	1	Journal of Biological Chemistry	1905	U.S.A.	47	3.63
2.	2	Journal of Economic Entomology	1908	U.S.A.	29	2.24
3.	2	Bulletin of Envirnnmental Contamination & Toxicology	1966	U.S.A	29	2.24
4.	3	*Journal of Fisheries Research Board Canada	1934	Canada	26	2.00
5.	4	Indian Journal of Experimental Biology	1963	India	25	1.93
6.	5	Biochemica et Biophysica Acta	1947	Netherland	24	1.86
7.	6	American Fisheries Society, Transactions	1870	U.S.A.	20	1.55
8.	6	Water Research	1967	U.S.A.	20	1.55
9.	7	Indian Journal of Environmental Health	1959	India	17	1.32
10.	8	Science	1880	U.S.A.	15	1.16
11.	9	Current Science	1932	India	14	1.08
12.	9	Hydrobiologia	1948	Netherlands	14	1.08
13.	10	Comparative Biochemistry & Physiology	1960	U.S.A.	13	1.00
14.	11	Canadian Journal of Zoology	1929	Canada	12	0.93
15.	11	Nature	1869	England	12	0.93
16.	11	Toxicology & Applied Pharmacology	1959	U.S.A.	12	0.93
17.	12	Geobios	1974	India	11	0.85
18.	12	Sewage and Industrial Waste	1921	U.S.A.	11	0.85
19.	13	Marine Biology	1967	U.S.A.	10	0.77
20.	13	Plant Physiology	1926	U.S.A.	10	0.77
21.	13	Indian Academy of Science, Proceedings	1934	India	10	0.77

Note: * Changed into Journal of Water Pollution Control Federation
** Percentage of citations is out of 1292 citations

From Table 10, it can be ascertained that the journal entitled *Journal of Biological Chemistry* is the most productive journal having been cited 47 times. There are 274 (57.80%) journals which have been cited only once and other 76 (16.03%) twice. All these 21 highly cited journals are in English language, originating from U.S.A. (11), India (5), Netherlands (2), Canada (2), and England (1).

Self-Citation Pattern

Among the cited literature (1800) of 132 research papers 181 (10%) are from the contributors' own literature/papers. An analysis of 1292 journal citations collected from the *JEB* source journal shows that there are only five citations of the source journal. Thus, the self-citing rate of the *JEB* is very poor, i.e. 0.39%. A number of factors may be responsible for this poor self-citing rate of the source journal, *JEB* such as,

i) Currently started journal
ii) Non-popularity of the journal
iii) Quality of the citing research papers
iv) Tendency of the contributor(s) to cite the foreign literature.
(v) Lack of relevancy among the citing research papers of the journal

CONCLUSIONS

The foregoing analysis of the *Journal of Environmental Biology* (1980-84) shows that there is a gradual increase in the number of research papers published in the journal every year and side by side the time lag is also increasing. This represents the growth of the literature in the subject. If the research papers are published with a minimal time lag, it would be helpful to avoid the duplication in research or in other words research-in-parallel and also accelerate the research-in-series. A low cited journal cannot be a core journal of the subject, so for the same it requires some improvements with regard to nature of contribution, time lag, quality of the research papers etc. The hyperbolic nature of the Bradford's bibliograph represents the developed nature of the subject. The self-citing rate of the source journal is a mirror that signified its image over the scientific world. The citation patterns indicate that the literature in the environmental biology is so widely scattered that it requires to be covered by indexing and abstracting services for the bibliographical control.

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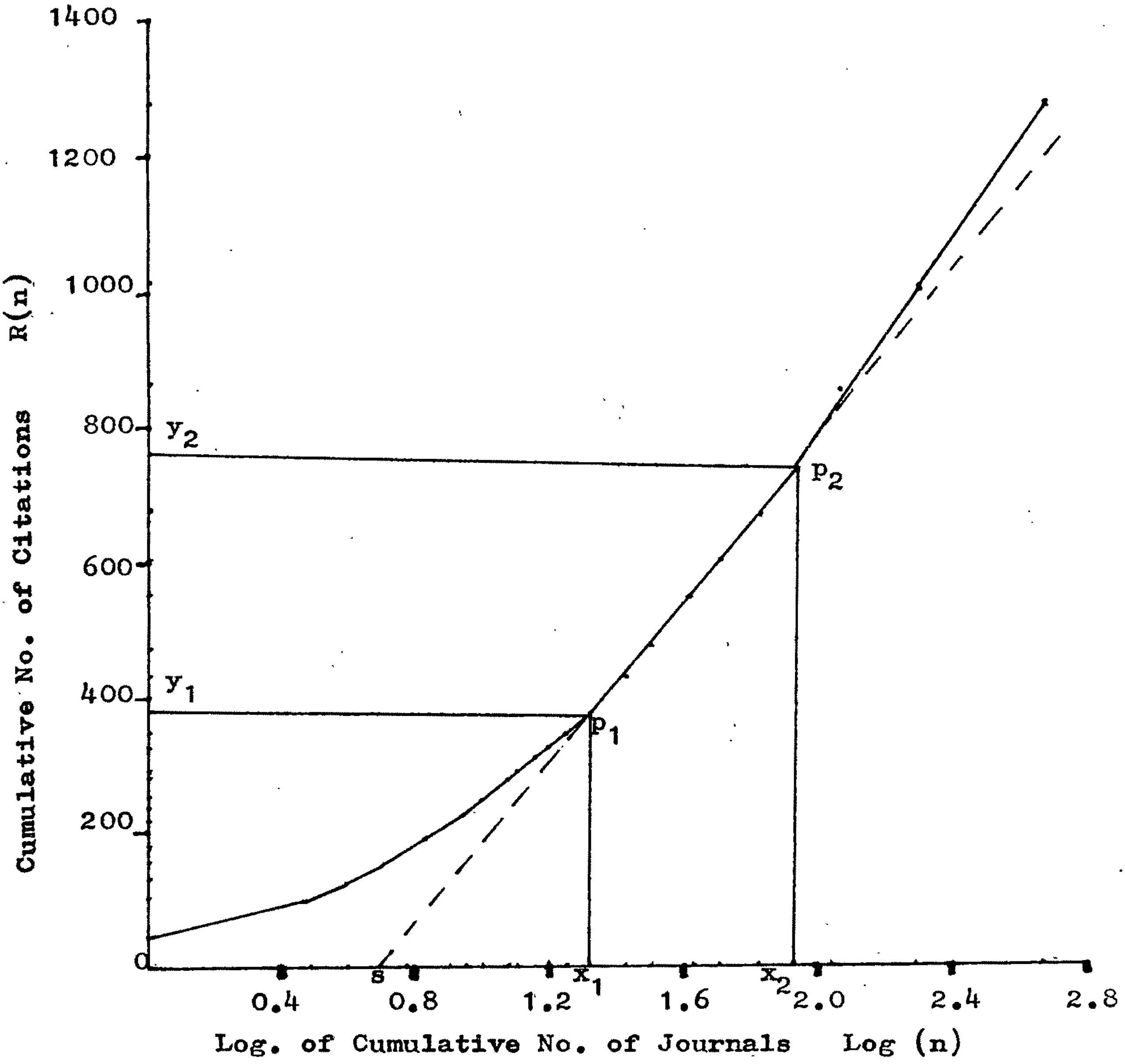

Fig. 1 : Bradford's Bibliograph

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COVERAGE OF THE IMMUNOLOGY LITERATURE IN *BIOLOGICAL ABSTRACTS, CHEMICAL ABSTRACTS and EXCERPTA MEDICA* : A STUDY ON OVERLAP, TIME LAG AND INDIAN CONTRIBUTION

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Examines the coverage of immunology literature in three well-known abstracting services, viz. Biological Abstracts, Chemical Abstracts and Excerpta Medica, with a view to determine overlap, time lag, subject slant and Indian contribution to the literature. Ascertains if there is any justification in acquiring more than one service in one and the same subject field. Using Bradford's bibliograph, derives a list of 50 core journals (covering 57.38% literature) in immunology to help research scholars, librarians and documentation officers in India.

INTRODUCTION

Abstracting and indexing services are in great use today. The growth in the abstracting and indexing services in science and technology has been spectacular. In 1900, there was one abstracting service for every 46 primary journals in the U.S., by 1930 this ratio was 1 to 24 and by 1950, 1 to 8 [1]. However, today there are approximately 2,500 secondary services published in all subject areas and in many languages in the world. Of these 1,500 are in English and approximately 300 of them are available in machine readable form [2]. With growing interdisciplinary research, the existing abstracting services have become interdisciplinary in their content. This has resulted in the overlapping of coverage in several services at once. It is especially so in the case of narrower areas like immunology. The matter assumes serious dimension as libraries have to pay for such duplication. Studies in the overlap of coverage are particularly valuable for libraries with small budgets and specialising in narrower areas. All these facts demand for comparative analysis of abstracting services; to what extent the duplication or overlap in coverage in a given subject occurs and whether there is any justification in acquiring more than one service in one and the same subject field. It is with this view that the present study was undertaken and the field of operation selected was immunology, it being an interdisciplinary area, where chances of overlap are more.

OBJECTIVES OF THE STUDY

The objectives of the study were to determine -

1. Extent of journal overlap in abstracting services covering the field of immunology;
2. Extent of article overlap in abstracting services;
3. The core journals in the field of immunology;
4. Number of articles abstracted from a periodical used as source material in these services;
5. Countrywise distribution of periodicals used as source material in these services;
6. Languagewise distribution of articles;
7. Time lag;
8. Slant in abstracts, and
9. Indian contribution to the field of immunology in terms of -
    - i) eminent authors;
    - ii) number of Indian journals covering immunology;
    - iii) number of institutions providing facilities for immunological research.

GOAL

The goal of this study was to ascertain if it would be necessary for the libraries specialising in immunology to have simultaneously *Biological Abstracts, Chemical Abstracts* and *Excerpta Medica* for ensuring full bibliographic access to the subject literature.

METHODOLOGY

The records of six months of *Biological Abstracts* (Immunology Section) were xeroxed and each record was separately mounted on a catalogue card. These cards were arranged alphabetically by author and then checked against the entire file of *Chemical Abstracts* (Immunochemistry Section) Volume 95, 96, 1982 and *Excerpta Medica* (Immunology, Serology and Transplantation) Volume 25,26 (Section 26), 1982, through their author index. If the item was traced in *Excerpta Medica,* the corresponding number from the latter was recorded on the right top of the card in orange colour. If the abstract was traceable in *Chemical Abstracts,* the abstract number from CA of that particular entry was put at the left hand top in sky blue colour. If the item was traced in CA and EM, the corresponding numbers from CA and EM were recorded on the card. At the end, the records bearing code numbers, say, of CA, EM or both, were separated from the main alphabetical sequence and counted. And then maximum possible overlap (i.e. three way overlap) among these services was determined. In the same way, two way overlap between BA and CA, BA and EM was also determined.

To achieve the objectives, 4,419 records were arranged in three different sequences - a) arranging these records by affiliation b) by the title of journal c) by the date of publication of journal articles. However, identification of slant in abstracts was achieved by using 5.22% articles which were common in all the three services.

ANALYSIS

Overlap

Overlap at article level

Table 1 shows overlap among these three abstracting services at journal article level. Of the 4,419 articles, 2,843 (64.33%) have been covered by *Biological Abstracts,* 449 (10.16%) by both *Biological Abstracts* and *Chemical Abstracts,* 896 (20.27%) by *Biological Abstracts* and *Excerpta Medica* and 231 (5.22%) by all three services. It is thus seen (Figure 1) that in the case of immunology, the total overlap is 35% and of this, 5% is covered by all three services.

It is seen from the Table 1 that although 35.65% records in BA overlap with either or both, the coverage of these three services is by and large varied. The difference in coverage is atributable to the difference in the source journals covered by these services.

Overlap at journal level

Table 2 presents the data about the total number of journal covered by these three abstracting services under immunology. BIOSIS monitors 642 journals on immunology, which form 6.8% of BIOSIS coverage. These 642 journals were checked with the (a) *List of journals Abstracted, Excerpta Medica,* 1983 and (b) *Chemical Abstracts Serial Source Index,* 1979. A further search for additions or deletions of journals in CAS data base for the year 1980, 1981 and 1982 was carried by checking even numbered issues of *Chemical Abstracts* for those years.

The analysis showed that of these 642 journals, 89 (13.86%) are not covered by *Excerpta Medica* and 54 (8.41%) by *Chemical Abstracts.* While 17 titles are not covered by either of the two services.

It is therefore evident from the above analysis that the overlap in coverage of articles is much less than the overlap in coverage of journal titles by these three services. This makes it necessary for a research worker to seek help of all these three services for exhaustive coverage of the field of his interest, in the present case, immunology.

While these services may select the same journals as source materials, their choice for particular papers in them varies according to their orientation. Alternatively, the interdisciplinary nature of immunology results in the scatter of subject literature and accounts for this variation at two levels.

This is supported by the expanded study of overlap carried out by National Federation of Abstracting and Indexing Services (NFAIS)

Table 1: Overlap at article level

Total No. of Absracts	BA	BA&CA	BA&EM	BA,CA & EM
4,419	2,843	449	896	231
100%	64.33%	10.16%	20.27%	5.22%

Table 2: Total no. of journals covered by the Services

Name of the service	Total no. of Journals	Journals Covered	% of coverage of journals in respective database
BIOSIS	9,430	642	6.8%
CAS	14,000	588	4.2%
EM	4,500	554	12.3%

Table 3: Countrywise distribution of periodicals

S.No.	Name of the Country	No. of Periodicals	%	Cum %
1.	USA	158	24.61	-
2.	UK	71	11.05	35.66
3.	Japan	71	11.05	46.71
4.	USSR	58	9.03	55.74
5.	Germany (E & W)	53	8.25	63.99
6.	France	25	3.89	67.88
7.	Netherlands	25	3.89	71.71
8.	Switzerland	25	3.89	75.76
9.	Italy	19	2.95	78.61
10.	Denmark	18	2.80	81.41
11.	Czechoslovakia	13	2.02	83.43
12.	Poland	11	1.71	85.14
13.	India	10	1.55	86.69
14.	Others	75	13.31	99.78

[3,4,5]. The NFAIS had been studying the degree to which 14 major English language scientific and technical abstracting and indexing services overlap in their coverage of journal articles. Preliminary results indicated that journal overlap was extensive. Overlap in article coverage was expected to be much less.

Countrywise Distribution of Periodicals

It is clear from the Table 3 that the USA is the single country which accounts for 158 (24.61%) journals. These 158 journals contribute 2001 articles (45.28%) (Figure 2).

Table 4 shows the number of periodicals and the corresponding articles abstracted from them. After the USA, the second position is jointly held by the U.K. and Japan, each of which accounts for 71 (11.05%) journals. The 71 journals published from the U.K. contribute as many as 704 articles (15.93%). Whereas 71 journals published from Japan contribute only 201 articles (4.54%). The 3rd, 4th and 5th positions are occupied by the USSR - 58 journals and 309 articles (6.99%). Germany 53 journals and 303 articles (6.85%), France-25 journals and 44 articles (0.99%), the Netherlands 25 journals and 227 articles (5.13%) and Switzerland 25 journals and 111 articles (2.51%). The first ten countries together account for over 80% periodicals and the remaining 20% periodicals are distributed among 32 countries. This can be interpreted to mean that most of the immunology literature is being published from these ten countries.

Core Periodicals

The 642 journals contributing to the immunology literature were arranged in decreasing order of contribution, i.e. in this context, contribution amounted to the number of articles abstracted from each journal. The analysis showed that the highest number of articles have been abstracted from the *Journal of Immunology*. The obvious reason is that the journal is completely devoted to the subject immunology. The first 50 (7.78%) journals accounted for as many as 2,536 (57.38%) abstracts and the remaining 1,883 (42.62%) abstracts have emanated from 592 journals (92.21%). Thus, these 50 journals, if their contribution in terms of articles abstracted is taken into consideration can be considered as the core journals in the field of

Table 4: Countrywise distribution of journals and articles

S. No.	Name of the country	No. of Journals	No. of Articles	%	Cum %
1.	USA	158	2001	42.28	-
2.	UK	71	704	15.93	58.21
3.	USSR	58	309	6.99	65.20
4.	Germany	53	303	6.85	72.05
5.	Netherlands	25	227	5.13	77.18
6.	Japan	71	201	4.54	81.72
7.	Switzerland	25	111	2.51	84.23
8.	Denkark	18	82	1.85	86.08
9.	India	10	56	1.26	87.34
10.	Italy	19	45	1.01	88.35
11.	Poland	11	45	1.01	89.36
12.	France	25	44	0.99	90.35
13.	Canada	5	30	0.67	91.02
14.	Czechoslavakia	13	30	0.67	91.69
15.	Others	50	238	8.65	99.78

immunology. However, this would be quantitative measure and not qualitative.

Thus, these 50 journals cover 57% literature on immunology. It is interesting to note that the first five of these contribute about 25% of the total subject literature. Obviously, these first five journals are very significant.

Bibliograph

From the analysis of the periodicals it was found that most of the immunology literature is concentrated among a few more productive journals and the rest of the literature is dispersed among many journals. Thus what Bradford found in case of applied geography and lubrication also holds good in the field of immunology. Bradford described a scattering pattern of journals in the area of applied geophysics, and lubrication in 1934[6]. In this case, Bradford's bibliography was plotted by arranging journals in decreasing order of their contribution on semilogrithimic graph paper. Figure 4 is a bibliograph displaying the scatter of paper in the field of immunology displaying the scatter of paper in the field of immunology as found in the present study. In the graph, A is the point from which the straight line starts, from A, AX1 was drawn parallel to Y axis and AY1 parallel to X axis. The interpretation shows that four journals give 930 articles, the next 930 i.e. (1860) articles come from 16 journals, the third 930 i.e. (2790) from 64 journals and the fourth 930 i.e. (3720) from 256 journals.

Thus, for the constant number of articles, i.e. for 933 articles, the number of journals went up increasing in the multiple of "4" in each successive zone i.e. 4:16:64:256:1024.

The first 84 (13.08%) journals, falling in three zones, account for 63.34% articles and the remaining 36.64% articles are scattered over

Table 5: Core Journals in Immunology

S No	Name of Journal	No. of articles abstracted	%	Cum %
1.	J IMMUNOL	482	10.90	–
2.	INFECT IMMUN	168	3.80	14.70
3.	J EXP MED	145	3.28	17.98
4.	CELL IMMUNOL	138	3.12	21.10
5.	IMMUNOLOGY	138	3.12	24.22
6.	MOL IMMUNOL	127	2.87	27.09
7.	ZHMICROBIOL EPIDEMIOL IMMUNOBIOL	95	2.14	29.23
8.	EUR J IMMUNOL	94	2.14	29.33
9.	J IMMUNOL METHODS	77	1.74	33.09
10.	PROC NATL ACAD	64	1.44	34.53
11.	CLIN IMMUNOL IMMUNOPATHOL	56	1.26	35.79
12.	SCAND J IMMUNOL	53	1.19	36.98
13.	J CLIN INVEST	50	1.13	38.11
14.	AM J VETRES	44	0.99	39.10
15.	IMMUNOL LETT	38	0.85	39.95
16.	TER ARKH	38	0.85	40.80
17.	TRANSPLANTATION	37	0.83	41.63
18.	INT ARCH ALLERGY APPL IMMUNOL	35	0.79	42.42
19.	J INFECT DIS	34	0.76	43.18
20.	IMMUNOBIOLOGY	33	0.74	43.92
21.	ARCH IMMUNOL THEREXP	28	0.63	44.55
22.	EXP PARASITOL	25	0.56	45.17
23.	TRANSFUSION	25	0.56	45.67

1	2	3	4	5
24.	ACTA PATHOL MICROBIOL SCAND SEC C IMMUNOL	24	0.54	46.21
25.	ARTHRITIS RHEM	24	0.54	46.75
26.	AM J T ROP MED HYG	23	0.52	47.27
27.	DEV COMMIMMUNOL	23	0.52	47.79
28.	BIOCHEMISTRY	22	0.49	48.28
29.	TISSUE ANTIGEN	22	0.49	48.77
30.	AM J CLIN PATHOL	21	0.47	49.24
31.	J RETICULOENDOTHEL SOC	21	0.47	49.71
32.	IMMUNOGENETICS	20	0.45	50.16
33.	SCIENCE	20	0.45	50.61
34.	ZENTRALABL BAKTERIOL MICROBIOL HYG J APTOPIG MED MIKROBIOL INTER - KRONSKE PARASITOL	20	0.45	51.06
35.	BIOCHEM J	19	0.42	51.48
36.	VOX SANG	19	0.42	51.90
37.	BYULL EKSPBIOL MED	18	0.40	52.30
38.	JPN J PARASITOL	18	0.40	52.70
39.	ARCH DERMATOL	17	0.38	53.08
40.	BIOCHEM BIOPHYS ACTA	17	0.38	53.46
41.	IMMUNOL COMMUN	17	0.38	53.84
42.	J INVEST DERMATOL	17	0.38	54.60
43.	J RHEUMATOL	17	0.38	54.60
44.	NEPHRON	17	0.38	54.98
45.	BR J DERMATOL	16	0.36	55.34
46.	J CLIN IMMUNOL	16	0.36	55.70
47.	J LAB CLINMED	16	0.36	56.06
48.	J MED VIROL	16	0.36	56.42
49.	THYMUS	16	0.36	56.78
50.	VET IMMUNOL IMMUNO PATHOL	15	0.33	57.11

Table 6

From Data		From Graph	
Journal	Reference	Journal	Reference
4	933	4	930
16	1013	17	1860
64	977	68	2790

558 journals (86.42%). For the articles in the 4th and 5th zones, libraries and information centres can think of interlibrary loan services or photocopying, so that complete coverage of the subject field is assured to the users.

Languagewise Distribution of Articles

From the Table 7 it is clear that 4,419 articles are distributed in 23 languages. The first position is occupied by the English language.

As seen from the piediagram (figure 5) 84.38% literature in the field of immunology is published in English. The remaining 15.62% literature is covered by as many as 22 languages. This can be interpreted to mean that language barrier is comparatively stronger for the immunologist working in non-English speaking

Table 7: Languagewise distribution of articles

Sl.No.	Language	No. of abstracts	%	Cumulative %
1.	English	3728	84.38	-
2.	Russian	347	7.85	92.23
3.	Japanese	109	2.46	94.69
4.	German	57	1.28	95.97
5.	French	36	0.81	96.78
6.	Italian	35	0.79	97.57
7.	Spanish	30	0.67	98.24
8.	Polish	16	0.36	98.60
9.	Korean	10	0.22	98.82
10.	Slovak	7	0.15	98.97
11.	Others	50	1.08	99.91

world as most of the literature in the field of immunology is published in English.

The other languages which are significant are Russian, Japanese, German, French, Italian and Spanish contributing 7.85%, 2.46%, 1.28% 0.81%, 0.79% and 0.67% literature respectively.

Time Lag

There is always a substantial time gap between the inception of research and the publication of its results in a journal. There are further delays between the time an articles or a report appears in a journal and the time it is indexed or abstracted in secondary service. The time lag between the appearance of a journal article and its announcement in a secondary service can be estimated by computing the number of months elapsing between the date printed on the issue of the secondary publication and the date of the citation it contains. In this study, time lag thus denotes the time span (in months) between the appearance of journal articles and their announcement in abstracting services.

It is clear from the Table 8 that 3,507 (79.36%) articles published in 1981 were recorded in 1982, 735 (16.64%) articles published in 1982 were covered in 1982 itself. While only 177 (4%) articles, announced in 1982, had been published in 1980.

According to Rowley and Turner [7] the time lag with abstracting service is unlikely to be below three months. Whereas, in the opinion of Guha [8] the time lag for psychology is 15 months. However, according to Lancaster [9] the time-lag is usually six months.

From Table 8 it can be said that for about 16.4% articles covered in the present study, the time lag was about six months, for 79.64% articles 9-12 months and for the remaining 4% it was about 12-18 months.

One of the reasons for a longer time lag could be the language and country of origin. In a study carried out by Carson & Wyatt [10] it was seen that the time lag varies from country to country. For *Biological Abstracts,* the time lag in the case of USA is 17 weeks, UK 21 weeks, S. Africa 18, and India 29 weeks. Considering this point, a further analysis of the 4% articles belonging to 1980 was made which showed that out of 177 (4%) articles, 156 were Russian, 5 English, 3 Polish, 2 Japanese, 2 Italian, 2 Serbo-Croat and one each in German, French, Belgarian, Romanian, Spanish, Beloruse and Ukarainian. When this data was compared with the total Russian literature abstracted during the six months, under consideration, it was revealed that out of 347 articles, about 156 (44.95%) were published in 1980, 190 (54.75%) in 1981 and only one article in 1982.

Table 8: Break up of original articles abstracted in 1982

Name of the Service	Total No. of entries	1980	1981	1982
Biological Abstracts (1982)	4,419	177	3,507	735
	100%	4%	79.36%	16.69%

Thus, from this data it can be concluded that for Russian literature the time lag is comparatively greater.

Indian Contribution

As this analysis was underway, the author's interest was aroused in examining the status of Indian contribution in this highly specialised and developing field of immunology. Keeping this view in mind, the data collected were arranged in such a way as to get a clear picture of the status of Immunology in India, vis-a-vis its global position.

From the analysis it was revealed that India contributed 74 research papers to the field of Immunology in the year 1982. (i.e. during the six months under examination) which forms 1.67% of total output in immunology as reported in *Biological Abstracts* (i.e. 4,419 records).

The alphabetical author list showed that Indian authors have not only published their research work in Indian journals (56 (75.6%) out of 76 papers) but also in foreign journals (18 (24.4%)).

The list of affiliation showed that a number of centres, colleges, departments, hospitals, institutions and Universities are involved in immunological research in India. From the data on research workers and institutions it is evident that India is not lagging far behind in immunological research.

The list of journals revealed that there are 10 Indian Journals (1.55% of 642 journals) covering the field of immunology (Table 9). Out of these 10 journals, all covered by *Biological Abstracts,* seven are covered by *Chemical Abstracts* and *Excerpta Medica* also, of the remaining three journals, one *(J Post-Grade Med Bom)* is not covered by either *Chemical Abstracts* or *Excerpta Medica;* another is covered by *Chemical Abstracts* (Bull Haff Inst) but not by *Excerpta Medica* and still another by *Excerpta Medica (J Commun Dis)* but not by *Chemical Abstracts.*

Indian Journal of Medical Research occupied the first position, when journals were arranged in order of decreasing productivity (Table 10). This showed that most of the immunology literature in India is published in *Ind J Med Res* and *Ind J Exp Biol.*

These 10 journals account for 56 papers (75.6%) and the remaining 18 papers (24.48%) were published in 18 foreign journals, from Switzerland, Czechoslovakia, S. Africa, U.S.A., France, Maxico, Austria, the Netherlands, U.K. and West Germany respectively.

From the above facts, it can be said that a good number of research workers and institutions in India are engaged in research on various aspects of immunology. From the point of journal, there is no single journal devoted exclusively to the field of immunology. However, this aspect will be given priority once the projected National Institute of Immunology becomes operational at New Delhi [11].

Further, Indian data regarding journals showed that there were only ten journals covering the field of immunology. However, in the opinion of present author, there could be more journals covering immunology. Perhaps these ten journals only could find place in BA during the six months selected for the study.

The list of periodicals Abstracted in *Indian Science Abstracts* [12] and *Current Indian Periodicals in English* [13] were searched to obtain information regarding the number of journals which are likely to cover the field of immunology. The list in *Indian Science Abstracts* records 62 titles, whereas Gidwani's annoted guide lists about 144 titles.

Table 9: Coverage of Indian Journals by BA,CA and EM

S.No.	Name of Journal covered by	BA	CA	EM
1.	Bull Haff	c	c	nc
2	Bull Post-Grade Inst	c	c	c
3.	Ind J Anim Sci	c	c	c
4.	Ind J Biocem Biophy	c	c	c
5.	Ind J Exp Biol	c	c	c
6.	Ind J Med Res	c	c	c
7.	Ind J Micro	c	c	c
8.	Ind J Phy Pharma	c	c	c
9.	J Commun Dis	c	nc	c
10.	J Post-Med (Bombay)	c	nc	nc

c = covered. nc = not covered.

Table 10: Indian Journals arranged in order of decreasing contribution

S.No.	Name of the Journal	No. of abstracts
1.	Ind J Med Res	33
2.	Ind J Exp Biol	9
3.	Ind J Anim Sci	4
4.	Bull Post-Grad Inst Med	3
5.	Ind J Biochem Biophy	2
6.	Bull Haff Inst	1
7.	Ind J Microbiol	1
8.	Ind J Physiol Pharmacol	1
9.	J Commun Dis	1
10.	J Post-Grad Med (Bombay)	1

The other facts revealed by the analysis are that (i) Indian research workers increasingly prefer Indian journals for publishing their research results, or alternatively, communication channels exist in India for the benefit of Indian research workers; (ii) the journals devoted to more specific field, (e.g. *Bull Haff Inst)* and others where more contribution was expected, are in the lower half of the table (Table 10).

Slant in Abstracts

Many times a document contains information of interest at once to specialists working in different subject fields. Such a document will normally be abstracted with specific slant to meet the needs of a particular specialist e.g. *Chemical Abstracting Service* may abstract the component of biochemical work on biology indicatively and component of chemistry informatively. Thus, the resulting abstract is suitable for chemists. On the other hand, *Biological Abstracting Service,* may abstract the chemical parts of research paper indicatively and biological parts informatively. Thus, two abstracts of the same document prepared for two different audiences might be quite different. Borko [14] and Bhat [15] have shown that slant does exist in abstracts. However, Neelameghan and Raghavendra Rao reported that there was very little difference in the kernel ideas presented in the abstract of one and the same article covered in *Chemical Abstracts* and *Physics Abstracts.* Since the kernal ideas presented in the abstract for an article were more or less the same in *Chemical Abstracts* and *Physics Abstracts,* there was practically no slant in the abstract in the usual sense. [16].

Further, Neelameghan has shown that abstracts in each service are slanted to the needs of Chemists and Physicists respectively by placing the abstracts under different subject headings, for example,

Subject heading in Physics Abstracts	**Subject heading in Chemical Abstracts**
1. Solid State Physics	Electrical & Magnetic Phenomena
2. Magnetic Properties Solids	Electrical & Magnetic Phenomena
3. Gravitation-Relativity	General Physical Chemistry
4. Lattice Mechanics	Thermodynamics, Thermochemistry and Thermal Properties.

Against this background, the author made an attempt to find slant in abstracts in its usual sense or otherwise. During the discussion on the overlap in abstracts at the article level (Table 1) it was shown that there were 231 (5.22%) abstracts covered by all three abstracting services. A 10% sample of this population was taken for the examination. Then for each of these 10% papers the abstracts prepared by *Biological Abstracts, Chemical Abstracts* and *Excerpta Medica* were collected and were thoroughly examined. A content analysis of these 23 abstracts prepared by these three different services showed that in most of the cases abstracts prepared by *BIOSIS* and *Excerpta Medica* were identical. It is obvious enough, as both these services cover biomedical field. However, surprisingly similar results were observed in *Chemical Abstracts* when the same abstracts from it were compared with those appearing in *Biological Abstracts* and *Excerpta Medica.* This was not expected as a thorough examination revealed that in a few abstracts, there was little difference in the subject matter; abstracts were otherwise identical in all the three abstracting services. Though some minor changes in the information content of the abstracts prepared by these three services were noticeable, all the three services ensured no significant information loss on the part of research workers.

This indicates that practically there was no slant in the abstracts prepared by BA, CA and EM. Moreover, identical information presented in abstracts prepared by these three services suggests that (a) perhaps these services accepted, at least in these particular cases, author abstracts (i.e. summary or abstract provided by the author himself in the beginning of the articles with a few modifications in the texts) (b) abstracts might have been prepared by the same group of professional abstractors for BA, EM and CA and these services might have made few changes in the text.

The above observation has been supported by the findings of Bhat [17]. He concluded that hardly any difference (in the field of Biochemistry) was found between the author abstracts published in various abstracting services like *Indian Science Abstracts, Chemical Abstracts, Biological Abstracts, Excerpta Medica* and *International Pharmaceutical Abstracts.* Both the observations prove more than correct if one refers to Perkins about preparing the BIOSIS abstracts, "an extremely important source (about 25%) of abstracts comes through the efforts of leading primary journal editors: editors of a growing number of major journals require the author to submit an abstract with his manuscript. The edited abstract is printed customarily at the begining of the journal article. Such 'heading' abstracts, after evaluation, can often be used in BA without further editorial alteration of texts" [18]

CONCLUSIONS

The conclusions arrived at in this study and recorded below are based upon the evidence collected from *Biological Abstracts* with the only exception of the first and last conclusions which are apropos BA, CA, & EM. The conclusions are thus valid in so far as they refer to the contents of *Biological Abstracts.*

1. The BA/CA/EM overlap study has provided evidence that the number of occurrences of all the three services having selected the same articles for abstracting is not significantly large. The maximum possible overlap among these three services at article level was 5.22% and two way overlap between BA and CA was 10.16% and BA and EM 20.27%. However, journal overlap among these three services was found to be extensive. Of 642 journals monitored by *Biological Abstracts,* 588 (91.58%) were covered by *Chemical Abstracts* and 533 (86.13%) by *Excerpta Medica.* This in turn makes it essential for a research scholar to seek help of all these three services for complete coverage of immunology literature. It is, however, suggested that a separate study may be undertaken to find out if the occurrence of overlap among these three services could be either greater or still smaller by changing the base from BA, as in this study, to either CA or EM. It is also advisable to undertake such comparative studies at time intervals to ascertain the change in the extent of overlap at journal and article levels. Further, it will be worthwhile to undertake a study to determine differences and similarities in the coverage of immunology literature in *Immunology Abstracts* as against *Biological Abstracts, Excerpt Medica, Chemical Abstracts* and *International Abstracts of Biological Sciences.* Such an overlap study will certainly give an idea about completeness of coverage of *Immunology Abstracts.* In that case, specialised research institutions in the field of immunology can think of subscribing to *Immunology Abstracts* only to ensure full bibliographic access.

2. The analysis of countrywise distribution of the relevant periodicals showed that more than 80% periodicals are published from the USA (158), the UK (71), Japan (71), the USSR (58), Germany (53), France (25), the Netherlands (25), Switzerland (25), Italy (19) and Denmark (18). These ten countries are the main producers of information channels (journals). These journals consitute the important channels for the communication of new research in the field of immunology.

3. It is hoped that list of journals given as 'core periodicals' in the field of immunology will help research scholars, librarians and documentalists at immunological research centres (for example, National Institute of Immunology, New Delhi) to formulate their acquisition policy with regard to serial publications. This list of periodicals can be used for guiding researchers in the field to primary sources of information.

It is already stated that first 50 journals in the ranked list cover 57.38% literature on immunology. It will be worthwhile here to invite the attention of research workers, librarians and documentalists in the field of immunology to the first five of these 50 journals which constitute 25% of the immunology literature. The remaining 32% literature is scattered in as many as 45 journals. Obviously these first five journals are very significant. They are, *J Immunol* - 10.90%, *Infect Immun* - 3.80%, *Immunol* - 3.12%, *Immunology* - 3.12%, *J Exp Med* - 2.28%.

4. The interpretation of the bibliograph revealed that in the field of immunology, for a constant number of articles (here 933) the number of journals increased in the multiple of '4' in each successive zone i.e. 4:16:64:256:1024. For the articles appearing in the fourth and fifth zone, the libraries can go in for interlibrary loan or photocopying, so that complete coverage of the subject is assured to the users.

5. In the field of immunology most of the literature (84.38%) is being published in English language. Russian, Japanese, German, French, Italian and Spanish language cover a good percentage of the remaining literature.

6. For most of the articles (79.36%), the time lage between the publication in source journal and their announcement in *Biological Abstracts* was found to be 9-12 months. For 16.64% articles it was about six months and for the remaining 4% articles it was about 12-18 months. The analysis also showed that Russian literature takes comparatively longer time (about 12-18 months) to be abstracted.

7. From data on research scholars and institutions, it is evident that India is not lagging far behind in immunology research. It is expected that in due course of time the immunologi-

cal research will gain momentum in the country once the projected National Institute of Immunology at New Delhi becomes fully operational.

8. The examination of the abstracts, prepared by these three services of the same document indicated that practically there was no slant in the abstracts prepared by BA, EM and CA. This in turn suggests that the use of author abstracts with little modification is on the increase. This is perhaps to reduce time lag.

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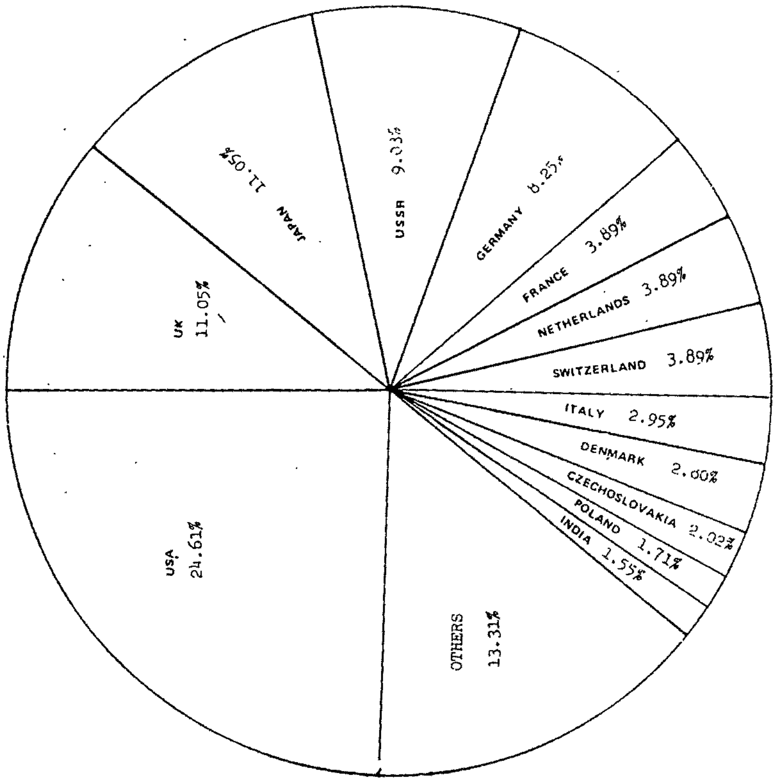

Fig. 2: Pie diagram showing countrywise distribution of periodicals

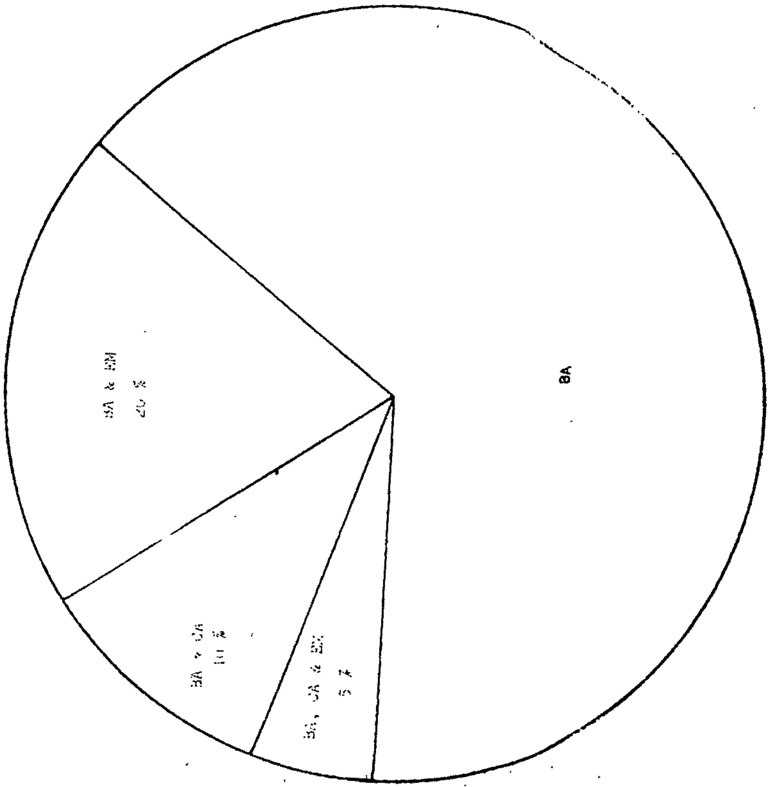

Fig. 1: Pie diagram showing overlap among articles between BA, CA & EM, BA & CA BA & EM

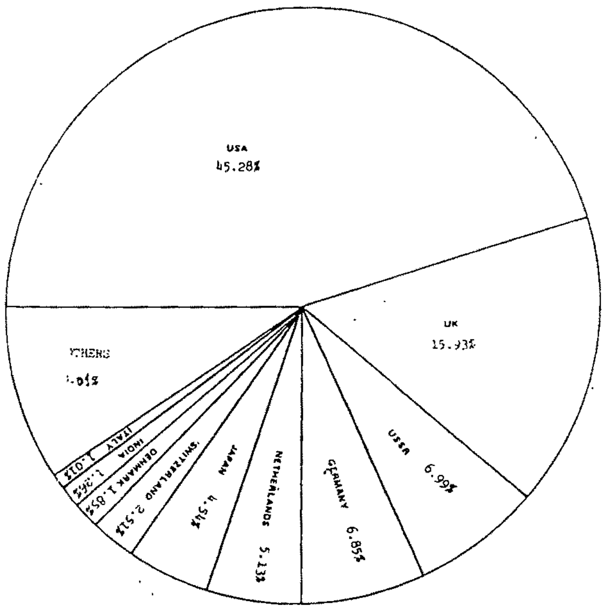

Fig.3: Pie diagram showing distribution of original articles

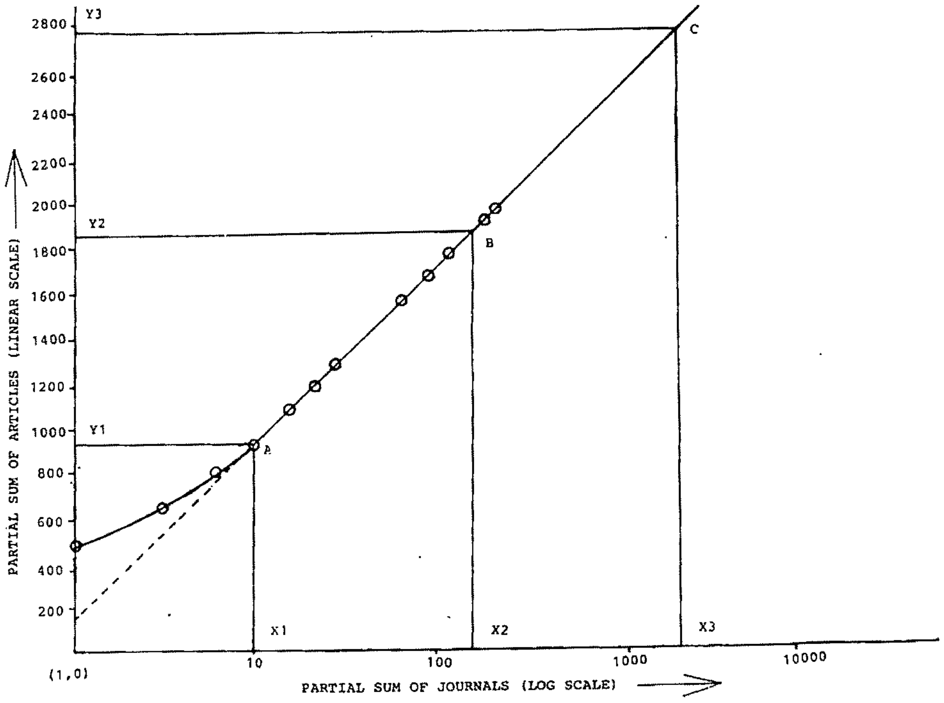

Fig. 4: Bibliograph displaying the scatter of papers in the field of immunology

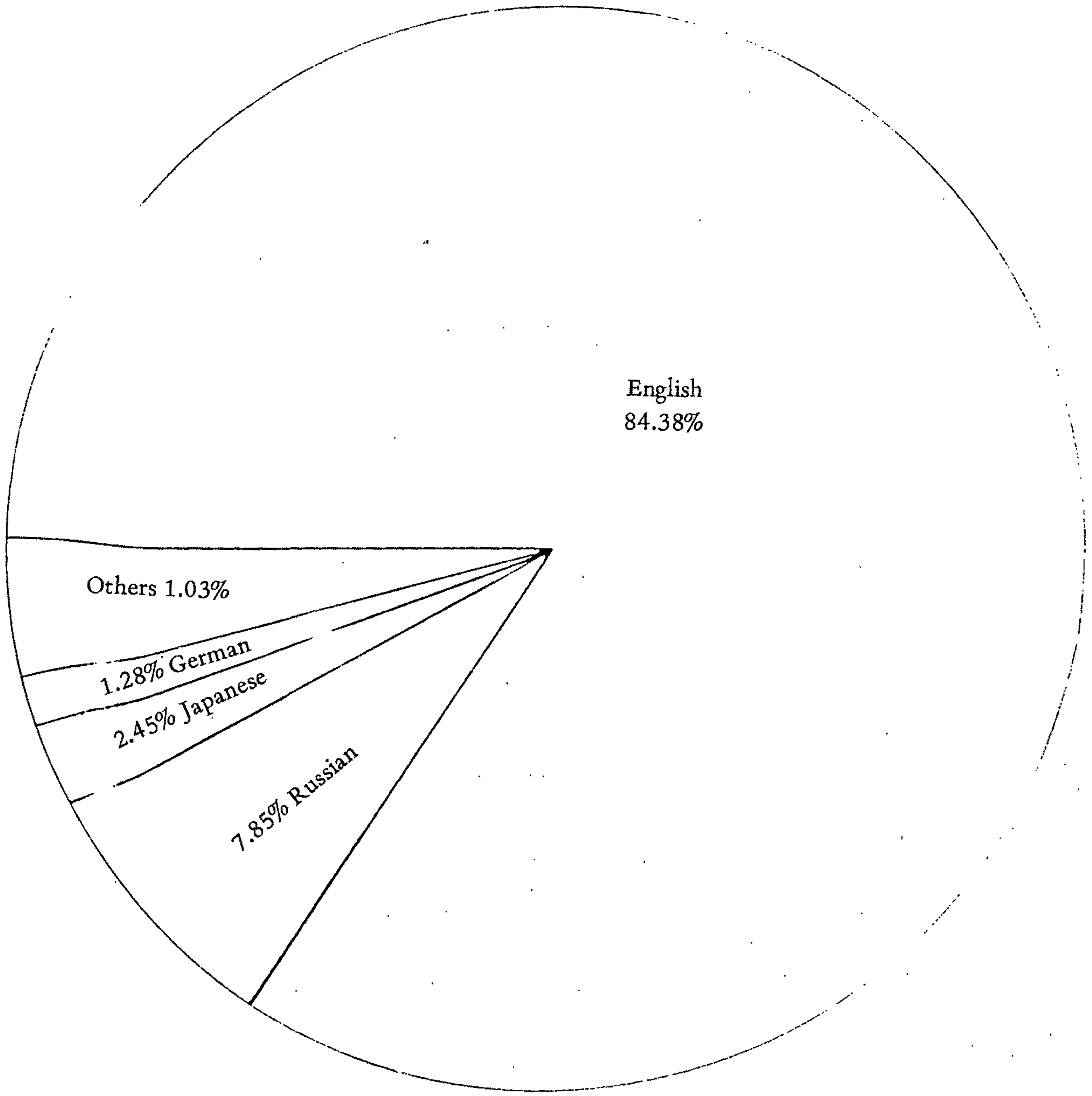

Fig. 5: Pie diagram showing languagewise distribution of articles

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FREQUENTLY CITED PERIODICALS BY INDIAN ORGANIC CHEMISTS : A CITATION ANALYSIS

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17638 citations appended to Indian Journal of Chemistry - Sec B-Vol.19(1980) - 23(1984) have been analysed. Institutional affiliation of authors and age distribution of citations have been tabulated. The periodicals most frequently cited by the Indian organic chemists including medicinal chemists have been identified. Countrywise distribution of foreign papers published in the journal has been given.

INTRODUCTION

Though the ancient Indians achieved contemporary excellence in several chemical processes including metallurgy and pharmaceuticals and deeply pondered over the structure of matter, chemistry in its modern sense can be considered to be just about 100 years old in India. The first report of a chemical research from India was published in 1896 by P.C. Roy [1]. However the growth of research in chemistry as in other areas occurred with the independence of the country. It has recently been estimated that the contribution of the Indian chemists is 3% to the total world chemical literature [2]. India has also been considered as superpower of the third world research [3].

Due to enormous growth of organic chemical literature and in the process of ensuring a comprehensive subject coverage with the budgetary limits, library and information section of this centre has to find an efficient mean of acquiring reasonably relevant resources for its researchers and technologists. To help organic chemical library in making decisions for planning and implementing its services, information on the characteristics of materials used by its users is essential.

Therefore, citation analysis has been carried out to know the publication practice of Indian scientists in the field of organic chemistry including medicinal chemistry and also to identify most frequently cited journals from the point of view of Indian organic chemists. Besides this, a survey has also been made as to the institutional affiliations of the authors and the age distribution of the journal citations.

CHOICE OF THE JOURNAL

The only Indian journal that has been exclusively devoted to the field of organic chemistry including medicinal chemistry is *Indian Journal of Chemistry Sec. B (IJC B)* published by Publications & Information Directorate of CSIR, New Delhi. According to a recent study [4], this journal ranks second with an impact factor of 1.9 among the third world journals. The contributors to this journal mostly belong to the Indian scientific community. Therefore, this journal has been chosen for the purpose of study. The period covered in this study is 1980-1984, Vol. 19-23B.

ANALYSIS

During the study period the *Indian Journal of Chemistry* Sec. B has published 2129 items of different categories, i.e. papers (994), notes (1055) and communications (80). On an average 400 items have been published per year. These data reveal not only the importance of this journal in the field of organic chemistry including medicinal chemistry but also the extent to which the Indian scientists depend upon this publication for getting their works published.

Analysis of the institutional affiliation of the author/s of the articles provides a picture of the relative levels of chemical research and development activity in different institution/s The data used in this analysis are based on the authors' address given in the papers, which reflect the institution in which the work was performed. Table 2 presents the breakdown by institutional affiliations of the authors who have contributed to the source journal. Institutions of higher education have contributed 60% of the papers published, government agencies 24.29% and private foundations 3.55%. It is interesting to note that foreign authors have contributed 12.56% of the articles. This further reveals that approximately 88% of the literature contributed is of Indian origin.

Table 3 presents the most productive Indian institutions of higher education and the number of papers contributed by each to the *IJC (B)*. These institutions are listed in descending order by the number of articles they have contributed. The Table reveals that the research in organic chemistry has been widely scattered over many Indian institutions. However, Table 4 reveals that the research in organic chemistry including medicinal chemistry has been concentrated in a very few government agencies which are specialised in this subject. Of the contributions from government agencies, 36.33% is from Central Drug Research Institute (CDRI), Lucknow, 30.15% from National Chemical Laboratory (NCL), Pune, and 5.62% from Research Centre of Indian Drugs and Pharmaceuticals Limited, Hyderabad. Of the contributions

Table 1: Indian Journal of Chemistry, Sec. - B (Organic, Medicinal Chemistry)

Vol/Year	Papers	Commtn.	Notes	Total	%
V.19B 1980	205	13	207	425	19.96
V.20B 1981	204	28	254	486	22.83
V.21B 1982	183	14	230	427	20.06
V.22B 1983	182	14	214	410	19.25
V.23B 1984	220	11	150	381	17.90
5 Years	994	80	1055	2129	100.00

Table 2: Productivity by type of institution

Institution	Papers	%
Institution of Higher Education	1310	59.60
Government Agencies	534	24.29
Private Foundations	78	3.55
Other Countries	276	12.56
Total	2198	100.00

Table 3: Institutions of Higher Educations

S.No.	Institution	Papers	%
1.	University of Delhi	125	9.55
2.	Panjab University, Chandigarh	82	6.25
3.	Indian Institute of Science, Bangalore	57	4.35
4.	University College of Science, Calcutta	50	3.81
5.	Banaras Hindu University, Varanasi	49	3.74
6.	Aligarh Muslim University, Aligarh	41	3.12
7.	Andhra University, Waltair	37	2.82
8.	Lucknow University, Lucknow	34	2.59
9.	Osmania University, Hyderabad	32	2.44
10.	University of Bombay	32	2.44
11.	I.I.T. Bombay	31	2.36
12.	Kakatiya University, Warangal	24	1.83
13.	University of Poona, Pune	24	1.83
14.	Karnataka University, Dharwad	23	1.75
15.	Kurukshetra University, Kurukshetra	22	1.67
16.	Annamalai University, Annamalai Nagar	21	1.60
17.	I.I.T., New Delhi	21	1.60
18.	Madurai Kamaraj University, Madurai	21	1.60
19.	University of Allahabad, Allahabad	21	1.60
20.	University of Rajasthan, Jaipur	20	1.52
21.	Gurunanak Dev Univeristy, Amritsar	19	1.45
22.	Jadavapur University, Calcutta	19	1.45
23.	Maharshi Dayananda University, Rohtak	17	1.29
24.	I.I.T., Kanpur	16	1.22
25.	King George's Medical College, Lucknow	16	1.22
26.	Ramnarain Ruia College, Bombay	16	1.22
27.	University of Madras, Madras	16	1.22
28.	University of Kerala, Trivandrum	16	1.22
29.	VHNSN College, Virudhunagar	16	1.22
30.	Institute of Sciences, Bombay	13	0.99
31.	Gulbarga University, Gulbarga	12	0.916
32.	PSG College of Arts and Science, Coimbatore	12	0.916
33.	I.I.T. Madras	10	0.763
34.	Punjab Agricultural University	10	0.763
35.	Vivekananda College, Madras	10	0.763
36.	Other 99 institutions	325	24.81
	Total	1310	100.00

Table 4: Government Agencies

S.No.	Agency	Publications	
		Papers	%
1.	Central Drug Research Institute, Lucknow	194	36.33
2.	National Chemical Laboratory, Pune	161	30.15
3.	IDPL Research Centre, Hyderabad	30	5.62
4.	Regional Research Laboratory, Jammu-Tawi	21	3.94
5.	Regional Research Laboratory, Jorhat	17	3.19
6.	Bhabha Atomic Research Centre, Bombay	16	2.99
7.	Regional Research Laboratory, Hyderabad	16	2.99
8.	Indian Association for the Cultivation of Science, Calcutta	15	2.81
9.	Central Food Technological Research Institution, Mysore	9	1.68
10.	Capt. Srinivasamurthy Drug Research Institute for Ayurveda, Madras	7	1.32
11.	Indian Institute of Chemical Biology, Calcutta	6	1.13
12.	Central Institute of Medicinal and Aromatic Plants, Lucknow	5	0.93
13.	Defence Research and Development Establishment, Gwalior	5	0.93
14.	Indian Agricultural Research Institute, New Delhi	5	0.93
15.	Regional Research Laboratory, Bhubaneswar	4	0.75
16.	Bose Institute, Calcutta	3	0.56
17.	DMSRDE, Kanpur	2	0.37
18.	Hindustan Antibiotics Ltd., Pimpri	2	0.37
19.	Indian Lac Research Institute, Ranchi	2	0.37
20.	Other 14 Institutions	14	2.63
	Total	534	99.98

Table 5: Private Foundations

S.No.	Name	Papers	%
1.	Ciba-Geigy Research Centre, Bombay	49	62.82
2.	East Indian Pharmaceutical Works, Calcutta	8	10.26
3.	Amrutanjan Ltd., Madras	7	8.98
4.	Multichem Research Centre, Vododan	4	5.13
5.	Haffkine Institute, Bombay	3	3.85
6.	Guffic Lab Pvt. Ltd., Kabilpore-3964001	2	2.56
7.	Cadila Lab, Ahmedabad	1	1.28
8.	Rickett and Colman of India Honore	1	1.28
9.	Hoechst India Ltd., Bombay	1	1.28
10.	HICO Products Ltd., Bombay	1	1.28
11.	Hindustan Lever Research Centre, Bombay	1	1.28
	Total	78	100.00

made by private establishments, M/s Ciba-Geigy Research Centre, Bombay has contributed 62.82%. The contribution from other private research establishments is very less. Table 6 presents the countrywise breakdown (excluding India) and reveals that substantial contribution has been made from Egypt - 172 articles (62.32%), followed by USA and UK. The table also shows the popularity of the journal in a number of foreign countries

CITATION ANALYSIS

As seen from Table 7, articles published in journals (85%) constitute the most important medium for scholarly communication in organic chemistry. Journal articles were found to be the largest single category of documents cited in *IJC (B)*. This is a clear indication of the importance of primary journals in developing subject collections, next in the order come book (10.35%) and patents (2.82%).

A list of core primary journals has been prepared on the basis of the number of citations (17, 638) received by the journals in the *IJC (B)* during the study period of 5 years. Table 8 shows ranking of 59 primary journals each of which received at least twenty citations during the five year period. Journals contributing fewer than 20 source items have been included as other journals. Ranking of journal titles in the above core list is based on the extent of use as reflected by the frequency with which the journal is cited by the author in *IJC (B)*. The titles at the top of the list are those that are more productive and are more extensively used as references than those at the bottom of the list.

An examination of the list reveals the familiar pattern of dispersion of the literature

Table 6: Papers from Abroad

Country	Papers	%	Country	Papers	%
Egypt	172	62.32	Saudi Arabia	2	0.72
U.S.A.	20	7.24	Iraq	2	0.72
U.K.	18	6.53	Nigeria	2	0.72
Japan	6	2.18	Norway	2	0.72
Canada	6	2.18	State of Qatar	2	0.72
Bangladesh	5	1.81	Thailand	1	0.36
Sri Lanka	5	1.81	France	1	0.36
Nepal	5	1.81	Iran	1	0.36
Korea	5	1.81	Venezuela	1	0.36
W. Germany	5	1.81	Switzerland	1	0.36
Pakistan	4	1.45	Sweden	1	0.36
Australia	3	1.08			
Italy	3	1.08	25 Countries	276	99.95
Denmark	3	1.08			

Table 7: Dispersion of Source Literature

Type of Document		No. of references cited	Percentage
Journal		17,638	85.63
Books		2,133	10.35
Patents		582	2.82
Theses/Dissertations		186	0.91
Conference Papers		43	0.21
Reports		16	0.07
	Total	20,598	99.99

Table 8: Ranked list of cited periodicals

Rank	Journal Title	Number of citations	Cumulative citations	Percentage of citations	Cumulative Percentage
1	2	3	4	5	6
1.	Indian Journal of Chemistry B	2524	2524	14.31	14.31
2.	Journal of American Chemical Society	1855	4379	10.51	24.82
3.	Journal of Organic Chemistry	1299	5678	7.36	32.18
4.	Journal of Chemical Society	1147	6825	6.50	38.68
5.	Tetrahedron Letters	969	7794	5.49	44.17
6.	Tetrahedron	724	8518	4.10	48.27
7.	Chemische Berichte	494	9012	2.80	51.07
8.	Journal of Indian Chemical Society	395	9407	2.24	53.31
9.	Journal of Medicinal Chemistry	380	9787	2.15	55.46
10.	Phytochemistry	356	10143	2.01	57.47
11.	Journal of Chemical Society Perkins Trans I	281	10424	1.59	59.06
12.	Synthesis	225	10649	1.28	60.34
13.	Australian Journal of Chemistry	206	10855	1.16	61.50
13.	Journal of Chemical Society Chemical Communications	206	11061	1.16	62.66
14.	Canadian Journal of Chemistry	196	11257	1.11	63.77
15.	Halvetica Chemica Acta	191	11448	1.08	64.85
15.	Liebigs Annalen der Chemie	191	11639	1.08	65.93
16.	Journal of Chemical Society "C"	188	11827	1.06	66.99
17.	Bulletin of the Chemical Society of Japan	168	11995	0.95	67.94
18.	Journal of Heterocyclic Chemistry	156	12151	0.88	68.82
19.	Bulletin de la Societe Chemique de France II	145	12296	0.82	69.64
20.	Chemistry and Industry	133	12429	0.75	70.39

1	2	3	4	5	6
21.	Current Science	127	12556	0.72	71.11
22.	Chemical Reviews	125	12681	0.70	71.81
23.	Chemical and Pharmaceutical Bulletin	120	12801	0.68	72.49
24.	Angewandte Chemie International English Edition	111	12912	0.63	73.12
25.	Journal of Chemical Society: Perkins Trans II	100	13012	0.56	73.68
26.	Journal of Scientific and Industrial Research	97	13109	0.55	74.23
27.	Journal fur Praktische Chemie	91	13200	0.51	74.74
28.	Proceedings of the Indian Academy Sciences	89	13289	0.50	75.24
29.	Yakugaku Zasshi (Journal of Pharmaceutical Society of Japan)	89	13378	0.50	75.74
29.	Nature	86	13464	0.48	76.22
30.	Journal of Pharmaceutical Sciences	84	13548	0.47	76.69
31.	Heterocycles	77	13625	0.43	77.12
32.	Organic Mass Spectrometry	74	13699	0.42	77.54
33.	Acta Chemica Scandinavica Sec B	67	13766	0.38	77.92
34.	Journal of Chemical Physics	64	13830	0.36	78.28
35.	Collection of Czechoslovak Chemical Communication	62	13892	0.35	78.63
36.	Zhurnal Obschei Khimii	57	13949	0.32	78.95
37.	Gazetta Chimica Italiana	55	14004	0.31	79.26
37.	Archive der Pharmazie	55	14059	0.31	79.57
38.	Monatshefte fur chemie	54	14113	0.30	79.87
38.	Experientia	54	14167	0.30	80.17
38	Arznimittel Forschung/Drug Research	54	14221	0.30	80.47
39.	Carbohydrate Research	53	14274	0.30	80.77
40.	Journal of Biological Chemistry	52	14326	0.29	81.06
40.	Egyptian Journal of Chemistry	52	14378	0.29	81.35

1	2	3	4	5	6
41.	Proceedings of the Society of Experimental Biology and Medicine	51	14429	0.29	81.64
42.	Journal of Physical Chemistry	48	14477	0.27	81.91
43.	Indian Journal of Experimental Biology	47	14524	0.26	82.17
44.	Annales de Chimie	44	14568	0.25	82.42
44,	Synthetic Communications	44	14612	0.25	82.67
45.	Bulletin des Societes Chimiques Belges	42	14654	0.24	82.91
46.	Comptes Rendus Ser II	40	14694	0.22	83.13
46.	Indian Journal of Pharmacology	40	14734	0.22	83.35
46.	Zeitschrift fur Naturforschung sec B	40	14774	0.22	83.57
47.	Accounts of Chemical Research	39	14813	0.22	83.79
47	Journal of Chemical Research	39	14852	0.22	84.01
47.	Recueil des Travaux Chimiques des Pays-bas (Journal of Royal Netherlands Chemical Society)	39	14891	0.22	84.23
48.	Planta Medica	33	14924	0.18	84.41
49	Agricultural and Biological Chemistry	32	14956	0.18	84.59
49.	Journal of Chemical Society "B"	32	14988	0.18	84.77
50.	Die Pharmazie	30	15018	0.17	84.94
50.	Organic Magnetic Resonance	30	15048	0.17	85.11
51	Biochemical Journal	29	15077	0.16	85.27
51.	Science	29	15106	0.16	85.43
52.	Chemicke Listy	28	15134	0.15	85.58
52.	Zhurnal Organicheskoi Khimii	28	15162	0.15	85.73
52	Zeitschrift fuer Physikalische Chemie	28	15190	0.15	85.88
53.	Journal of General Chemistry of USSR	27	15217	0.15	86.03
53	Quarterly Reviews	27	15244	0.15	86.18

1	2	3	4	5	6
54	Chemistry Letters	26	15270	0.14	86.32
55	Lloydia: Journal of Natural Products	25	15295	0.14	86.46
56	Khimiya Geterotsiklicheskikh Soedinenii	24	15319	0.13	86.59
57	Proceedings of the National Academy of Sciences of India	23	15343	0.13	86.72
57	Proceedings of the Royal Society of London	23	15365	0.13	86.85
57	Dokladii Akademii Nauk SSSR	23	15388	0.13	86.98
58.	Journal of Pharmacology and Experimental Therapeutics	22	15410	0.12	87.10
58.	Thermochemica Acta	22	15432	0.12	87.22
59.	European Journal of Medicinal Chemistry	21	15453	0.11	87.33
59.	Journal of Chemical Society: Faraday Transactions	21	15474	0.11	87.44
	Other 1716 Journals	2164	17638	12.27	99.71
	Total	17638	17638	-	99.71

similar to the pattern observed by Bradford. First 28 journals have accounted for 75% of the literature and the remaining 1766 journals have accounted for 25%. *Indian Journal of Chemistry* has been ranked as one with self citation rate of 14% of the total citations. Nine Indian journals have found place in the ranked list.

Shown in Table 9 is the age distribution of citations in intervals of 10 years in a tabular form. It may be observed that most of the citations are in the age group of 5-14 (1971-1980) (39.15%); 15-24 (1961-1970)-(26.48%); 25-34 (1951-1960)-(12.38%). The percentage of citations indicate the use of greater number of old citations. This observation is familiar to the chemistry area, because unlike life sciences new discoveries and new synthetic methods seem to be absorbed at a significantly slower rate [5]. Perhaps this may be the reason why the Indian organic chemists have cited more older journals than current journals.

CONCLUSION

The data presented may not be sufficient to arrive at a conclusion but still it indicates that the publications reporting the research results in organic chemistry including medicinal chemistry emanate overwhelmingly from the academic community and few specialised research institutions devoted to this specific subject field.

The ranked list of primary journals can serve as a selection tool in developing core collection of organic chemistry including medicinal chemistry journals.

The above study has helped to some extent in selective acquisition of periodicals in our research centre. However, this analysis has got some limitations as explained elsewhere[6]. This analysis will be useful not only to the special library management but also specialist readers in selecting the relevant journals in their field of study.

Table 9: Distribution of Journal Citations by age groups

Age (Years)	Number	Cumulative Number	%	Cumulative %
0 - 4 (1981-84)	1745	1745	9.90	9.90
5 - 14 (1971-80)	6906	8651	39.15	49.05
15 - 24 (1961-70)	4672	13323	26.48	75.53
25 - 34 (1951-60)	2185	15508	12.38	87.91
35 - 44 (1941-50)	918	16426	5.20	93.11
45 - 54 (1931-40)	536	16962	3.03	96.14
55 - 64 (1921-30)	294	17252	1.66	97.80
65 - 74 (1911-20)	144	17400	0.81	98.61
75 - 84 (1901-1910)	133	17533	0.75	99.36
85 - 194 (1800-1900)	105	17638	0.60	99.96
Total	17638	--	–	99.96

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INFORMATION NEEDS OF INDIAN FOOD SCIENTISTS. A CASE STUDY OF C.F.T.R.I., MYSORE

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Studies the information needs of food scientists and evaluates the services provided to them at CFTRI, Mysore. Results of the study are expected to be of help to those involved in planning and execution of effective information services in the field of food science and technology.

INTRODUCTION

The exponential growth of scientific literature, interdisciplinary nature of research and the trend towards specialisation have posed many problems to both users and providers of scientific information. Understanding the users means half the battle won in providing information services for research and development work. User studies are essential in building up need-based resources and in designing appropriate information systems. The present study is a typical one conducted in this direction at the Central Food Technological Research Institute (CFTRI), Mysore.

OBJECTIVES OF THE STUDY

The objectives of the study were:

(a) to ascertain the information needs of the food scientists regarding

   (i) the types of information required;
   (ii) the information sources used; and
   (iii) the various approaches to information

(b) to know the problems of access to information;

(c) to evaluate the various services provided by the information centre attached to CFTRI.

METHODOLOGY

A questionnaire was prepared keeping in view the objectives of the study. There are at present 324 scientists in this institute. Copies of the questionnaires were distributed to 100 scientists chosen randomly. Of these, 58 responded. The information obtained was tabulated and analysed.

FINDINGS

The main findings from the study are as follows

(a) The majority of the food scientists normally required information regarding, research and development (91.37%), current scientific research (87.93%) and bibliographical details (62.06%). Scientists requiring information regarding products, techno-economic developments and procedural aspects constitute 48.28%, 41.38% and 31.03% respectively of the total sample (Table 1).

(b) Journal literature is the most important form of literature required by the Indian food scientists. 53.44% of the scientists indicated their preference for the use of journal articles, 27.68% for abstracting and indexing journals and 20.68% for books (Table 2).

(c) Information on food science and technology is exchanged through invisible colleges also. 41.39% of the scientists exchange their preprints and reprints, whereas 27.58% of them communicate through letters. The various information channels of information used by the scientists are listed in Table 3.

(d) *Journal of Food Science and Technology* (India), *Food Technology* (U.S.A.) and *Journal of Food Science* (U.S.A.) are the journals most frequently used by these scientists (Table 4). U.S.A. (54.83%), U.K. (22.58%) and India (14.51%) are the three countries which produce 91.92% of the periodicals used by the scientists. Subject dispersion of periodicals was high.

(e) *Chemical Abstracts* (U.S.A.), *Food Science and Technology Abstracts* (U.K.) and *Biological Abstracts* (U.S.A.) are the abstracting journals commonly used and required by the scientists (Table 5).

(f) Abstracting and indexing journals (81.03%), reviews (77.58%) and references provided at the end of the articles and books (67.24%) are made use of by the scientists for literature search processes (Table 6).

(g) To keep themselves abreast of the latest developments in the fields of their interest, the majority of the scientists use periodicals (55.17%) and abstracting and indexing journals (32.75%) (Table 7).

(h) The majority of the scientists (75.86%) need active translation services from the following languages to English: German (63.79%), French (34.48%), Russian (25.86%) and Japanese (24.13%) (Table 8).

Table 1: Types of information needed by the food scientists

	Category of information needed	Number of scientists	% of total
(a)	Research and development information	53	91.38
(b)	Socio-economic information	14	21.14
(c)	Techno-economic information	24	41.38
(d)	Bibliographic information	36	62.06
(e)	Factual information	16	27.58
(f)	Current scientific information	51	87.93
(g)	Procedural information	18	31.03
(h)	Statistical information	18	31.03
(i)	Directory information	4	6.90
(j)	Products information	28	48.28

Table 2: Formal sources of information used by the food scientists

Nature of the sources	RANK NUMBER											
Formal sources, i.e. published	1	2	3	4	5	6	7	8	9	10	11	12
Books	12 (20.68)	19 (32.75)	9 (15.51)	2 (3.44)	2 (3.44)		1 (1.72)	1 (1.72)				
Journal articles	31 (53.44)	14 (24.13)	3 (5.17)		1 (1.72)			1 (1.72)				
Technical reports	7 (12.06)	6 (10.34)	7 (12.06)	6 (10.34)	3 (5.17)			2 (3.44)	3 (5.17)			
FAO/WHO reports	1 (1.72	3 (5.17)	6 (10.34)	5 (8.62)	1 (1.72)	3 (5.17)	2 (3.44)		1 (1.72)	3 (5.17)		2 (3.44)
Conference proceedings	2 (3.44)	5 (8.62)	9 (15.51)	6 (10.34)	8 (13.79)	3 (5.17)	3 (5.17)			1 (1.72)		
State of the art reports		3 (5.17)				2 (3.44)				1 (1.72)		
Abstracting and indexing journal	16 (27.58)	7 (12.06)	8 (13.79)	5 (8.62)	4 (6.89)	2 (3.44)	1 (1.72)	1 (1.72)		1 (1.72)	1 (1.72)	
Standards and specifications	3 (5.17)	1 (1.72)	4 (6.89)	1 (1.72)	4 (6.89)	3 (5.17)	5 (8.62)	1 (1.72)			1 (1.72)	
Food digests	2 (3.44)	5 (8.62)	4 (6.89)	6 (10.34)	3 (5.17)	2 (3.44)	4 (6.89)	1 (1.72)		1 (1.72)		
Bibliographies	2 (3.44)	2 (3.44)	4 (6.89)	2 (3.44)	3 (5.17)	3 (5.17)	1 (1.72)	3 (5.17)		1 (1.72)	4 (6.89)	
Directories		3 (5.17)	1 (1.72)		1 (1.72)		1 (1.72)				3 (5.17)	
Encyclopaedias	1 (1.72)	4 (6.89)	6 (10.34)		1 (1.72)			5 (8.62)	4 (6.89)		1 (1.72)	1 (1.72)
Newspaper clippings		2 (3.44)	4 (6.89)		1 (1.72)	3 (5.17)		1 (1.72)	2 (3.44)	3 (5.17)	1 (1.72)	
Annual reports		8 (13.72)	4 (6.89)	5 (8.62)	2 (3.44)	5 (8.62)	2 (3.44)	3 (5.17)	4 (6.89)	2 (3.44)	2 (3.44)	1 (1.72)

Table 3: Informal sources used by the scientists

Informal sources (unpublished)	RANK NUMBER				
Correspondences (letters)	16 (27.58%)	19 (32.75%)	8 (13.79%)	2 (3.44%)	-
Unpublished reports (e.g. classified reports)	4 (6.89%)	12 (20.68%)	6 (10.34%)	7 (12.06%)	-
Exchange of reprints and preprints	24 (41.39%)	16 (27.58%)	5 (8.62%)	-	-
Telephone communications	1 (1.72%)	3 (5.17%)	2 (3.44%)	2 (3.44%)	3 (5.17%)

Table 4: Rank list of journals

Sl. No.	Rank No.	Journal title	Country	Number of respondents	% of total
1	2	3	4	5	6
1	1	Journal of Food Science and Technology	India	37	63.79
2	2	Food Technology	U.S.A.	33	56.39
3	3	Journal of Food Science	U.S.A.	24	41.37
4	4	Journal of the Science of Food and Agriculture	U.K.	18	31.04
5	5	Journal of Agricultural and Food Chemistry	U.S.A.	17	29.31
6	6	Indian Food Packer	India	12	20.68
7	7	Science	U.S.A.	10	17.24
8	8	Journal of American Chemical Society	U.S.A.	9	15.51
9	9	New Scientists	U.K.	8	13.79
10	10	Nature	U.K.	7	12.06
11	10	Journal of Texture Studies	U.S.A.	7	12.06
12	10	Cereal Chemistry	U.S.A.	7	12.06
13	11	Food Manufacture	U.K.	6	10.34

1	2	3	4	5	6
14	11	Journal of Nutrition	U.S.A.	6	10.34
15	12	Cereal Science Today	U.S.A.	5	8.62
16	12	Journal of Food Biochemistry	U.S.A.	5	8.62
17	12	Indian Journal of Biochemistry and Biophysics	India	5	8.62
18	12	Food Engineering	U.S.A.	5	8.62
19	13	Journal of Food Quality	U.S.A.	4	6.89
20	13	Indian Journal of Microbiology	India	4	6.89
21	13	Lipids	U.S.A.	4	6.89
22	13	Baker's Digest	U.S.A	4	6.89
23	13	Journal of Horticultural Science	U.K.	4	6.89
24	14	Pesticide Science	U.K.	3	5.17
25	14	Journal of Biological Chemistry	U.S.A.	3	5.17
26	14	Biochemica et Biophysica Acta	Netherlands	3	5.17
27	14	Toxicology	Ireland	3	5.17
28	14	Journal of Dairy Science	U.S.A.	3	5.17
29	14	British Food Journal	U.K.	3	5.17
30	14	Nutrition Reviews	U.S.A.	3	5.17
31	14	Journal of Stored Products Research	U.S.A.	3	5.17
32	14	Annual Review of Microbiology	U.S.A.	3	5.17
33	14	Indian Spices	India	3	5.17
34	14	Journal of Insect Physiology	U.K.	3	5.17
35	15	Science and Culture	India	2	3.44
36	15	Journal of Lipid Research	U.S.A.	2	3.44
37	15	Food Chemistry	U.K.	2	3.44
38	15	American Journal of Clinical Pathology	U.S.A.	2	3.44
39	15	Food Products Development	U.S.A.	2	3.44
40	15	Indian Journal of Horticulture	India	2	3.44
41	15	Journal of Chromatography	U.S.A.	2	3.44
42	15	Analytical Chemistry	U.S.A.	2	3.44

1	2	3	4	5	6
43	15	Meat Science	U.K.	2	3.44
44	15	Analyst	U.K.	2	3.44
45	15	Journal of Economic Entomology	U.S.A.	2	3.44
46	16	Journal of Organic Chemistry	U.S.A.	1	1.72
47	16	Cereal Foods World	U.S.A.	1	1.72
48	16	Archives of Biochemistry and Biophysics	U.S.A.	1	1.72
49	16	Journal of Milk and Food Technology	U.S.A.	1	1.72
50	16	Food Technology in Australia	Australia	1	1.72
51	16	Journal of Thermal Biology	U.K.	1	1.72
52	16	American Miller and Processor	U.S.A.	1	1.72
53.	16	Food Research Institute Studies	U.S.A.	1	1.72
54	16	Indian Coffee	India	1	1.72
55	16	Madras Agricultural Journal	India	1	1.72
56	16	British Journal of Nutrition	U.K.	1	1.72
57	16	Plant Physiology	U.S.A.	1	1.72
58	16	Research and Development Management	U.S.A.	1	1.72
59	16	Biochemical Journal	U.K.	1	1.72
60	16	Life Science	U.S.A.	1	1.72
61	16	Physics and Chemistry of Lipids	U.K.	1	1.72

Table 5: Rank list of abstracting and indexing journals used by the scientists

Sl. No.	Rank No.	Journal title	Country	Number of respondents	% of total
1	1	Chemical Abstracts	U.S.A.	37	63.79
2	2	Food Science and Technology Abstracts	U.K.	36	62.68
3	3	Biological Abstracts	U.S.A.	15	25.86
4	4	Nutrition Abstracts and Reviews	U.K.	6	10.34
5	5	Paper and Board Abstracts	U.K.	5	8.62
6	6	Toxicology Abstracts	U.S.A.	4	6.89
7	6	Horticulture Abstracts	U.K.	4	6.89
8	7	Minerological Abstracts	U.K.	3	5.17
9	7	Analytical Abstracts	U.K.	3	5.17
10	8	Dairy Science Abstracts	U.K.	2	3.44

Table 6: Usefulness of various approaches to locate information

Methods	Most useful (% of respondents)	Moderately useful (% of respondents)	Least useful (% of respondents)	Not useful (% of respondents)
Approach to librarian	20.69	43.10	15.51	5.17
Use of library catalogue	50.00	43.10	6.89	--
References of bibliographies at the end of the articles or books	67.24	27.58	1.72	--
Separately published bibliographies	39.65	48.28	3.44	1.72
Abstracting and indexing journals	81.03	17.24	-	--
Reviews	77.58	17.24	-	--
Interpersonal communications	15.51	63.79	13.79	

Table 7: Sources used by the scientists to keep up-to-date with the latest developments

Sources	RANK NUMBER					
	1	2	3	4	5	6
Periodicals	32 (55.17%)	9 (15.51%)	3 (5.17%)	-	-	-
Conference proceedings	4 (6.89%)	6 (10.34%)	7 (12.06%)	12 (20.68%)	11 (18.96%)	-
Reprints	3 (5.17%)	5 (8.62%)	8 (13.79%)	11 (18.96%)	7 (12.06%)	5 (8.62%)
Reviews	6 (10.34%)	20 (34.48%)	12 (20.68%)	7 (12.06%)	-	-
Abstracting and indexing journals	19 (32.75%)	13 (22.41%)	10 (17.24%)	2 (3.44%)	3 (5.17%)	-
Informal contacts with colleagues	3 (5.17%)	6 (10.34%)	3 (5.17%)	1 (1.72%)	5 (8.62%)	16 (27.58%)

Table 8: Languages in which scientists feel strongly the need for translation

Language	Number of scientists	% of total
German	37	63.79
French	20	34.48
Russian	15	25.86
Japanese	14	24.13
Spanish	4	6.89
Italian	2	3.44
Chinese	2	3.44

(i) Table 9 gives the various services provided by the information centre attached to CFTRI. Most of the scientists are satisfied with the various documentation services provided by the centre. The scientists depend not only on the Institute's information centre for information but also on the services of other organisations like INSDOC (58.63%), DESIDOC (10.34%), FAO/WHO (75.86%), NATIS (25.86%), etc.

IMPLICATIONS OF THE STUDY

User studies aimed at ascertaining the information needs of specific groups are essential in designing information systems and in building up need-based resources in libraries. The results of the present study are expected to be of help, to those involved in planning and execution of effective information services in the field of food science and technology. They will also be of use to system designers, information planners and workers in taking rational day-to-day decisions with regard to acquisition of informational material and storage, retrieval and dissemination of information.

ACKNOWLEDGEMENT

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Table 9: Services provided by the institute library

Services	Adequate	Moderately adequate	Inadequate
Bibliographic services	55.17	25.86	5.17
Reference service	53.14	22.41	3.44
Abstracting and indexing service	60.39	22.41	-
Counter service	68.96	18.96	1.72
Inter-library loan	32.75	25.86	17.24
Food digest	51.72	24.13	1.72
Food product Service	43.10	24.13	3.44
Selective dissemination of information service	20.68	32.75	6.89
Technical enquiry service	34.48	24.13	3.44
Reprographic service	39.65	24.15	1.72

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CONTRIBUTIONS TO LIBRARY CLASSIFICATION IN INDIAN LIBRARY AND INFORMATION SCIENCE JOURNALS AND BOOKS, 1971-80: AN ANALYSIS

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INTRODUCTION

With the rapid growth of knowledge in every field of study, the subject of Library and Information Science is no more behind. The amount of literature on the subject is continuously increasing year after year. The number of journal articles in the field has also increased considerably in recent decades. India is also contributing its share to the world production of library literature every year [1].

The first periodical in Library and Information Science (LIS) in India was instituted in 1912 in Baroda (now in Gujarat state). It was entitled *Library Miscellany* and was the brainchild of Dr. William Bordon who was invited by the then Maharaja of Baroda, Sayajirao Gaekwad, for establishing a network of public libraries. This journal ceased publication in 1920. *Modern Librarian,* the second English language periodical started in 1930 from Lahore (now in Pakistan), earned a good name and reputation in the library world till it ceased publication in 1946. But immediately another journal *Indian Librarian* was commissioned from Lahore itself (shifted to Jullundur after partition in 1947); but it also ceased publication after 1982. The fourth English language journal *Library Bulletin* was started in 1942 by the Indian Library Association, but unfortunately it soon met its death. Another journal started two years after independence, but this also ceased after some time. Three more journals were launched during the 1950s and they are still continuing. More journals in Library and Information Science appeared on the scene during the 1960s and the 1970s.

At present there are about 25 periodicals being published from India with at least four journals emanating from Delhi alone. Though LIS periodicals have a history of more than 70 years now, the maximum number of them started appearing during the sixties and the seventies. However, some have also appeared on the scene in the early eighties. This increase in the number of journals has contributed to the growth of library literature in article form in the recent years. Another reason for the quantitative growth in Indian library literature is the fast increase in the number of LIS schools in the post-independence period, which totalled 55 by the end of 1984. Every year about 2,000 library science graduates, and about 200 master's degree holders in LIS are being produced in the country. About 14 LIS schools enrol students for the award of Ph.D. degrees, while there was only one such school in the country until the end of the 1960s. In these schools the strength of the faculty is about 200 or so, and most of them contribute to these professional journals. With this framework of the LIS education it is not surprising that the number of periodical articles is mounting year after year.

PURPOSE

The present paper is prepared with the purpose of analysing the Indian contributions on library classification to which the doyen of Indian librarianship, Dr. S.R. Ranganathan has contributed a great deal.

Though some articles have been written on the Indian contribution to classification, yet a careful study of library literature produced so far reveals that no analytical study of the nature of the present article has ever been conducted.

SCOPE

The scope of the paper is limited to *Library Classification.* It attempts to analyse the contributions made by the teachers, researchers, and students of LIS schools, working librarians in different library environments, and also, by foreign scholars.

It includes in its scope the periodical articles, books, and Ph.D. theses on library Classification published in India. Every effort has been made to lay hands on a variety of sources in order to cull out maximum amount of information; and the articles contributed in the *Encyclopedia of Library and Information Science* have also been included. It also includes an article contributed in Arthur Maltby's *Classification in the 1970's : A Second Look,* and another in *Coceptual Basis of the Classification of Knowledge,* edited by J.A. Wojciechowski.

Besides, articles on classification from a few edited books in India have also been included in the present analysis. This is done in order to give it a broader base and thereby make it as comprehensive as possible.

PERIOD COVERED

In view of the initiation of many new LIS journals, a period of ten years from 1971 to 1980 has been taken up for the present study. This decade is chosen also because by now the field of LIS in India has attained enough maturity and so is the case of library classification.

It was during this period that the Third International Study Conference on Classification Research was held in Bombay in 1975, the first of its kind in India, wherein library classification and allied areas were discussed keenly with an attempt towards universal classification through Board System of Ordering.

CHOICE OF PERIODICALS

LIS journals are not only published in English language but some are also brought out in regional languages of India. But the choice of periodicals is restricted to English language only, as it would have been well-nigh impossible to scan several periodicals being published in many regional languages.

However, sincere effort is made to scan through some such foreign periodicals where Indian authors mostly contribute their articles. The following periodicals are included (though more were scanned) for the present anlysis.

Indian

1. ALIS Bulletin
2. Annals of Library Science and Documentation
3. DRTC Annual Seminar
4. Herald of Library Science
5. IASLIC Bulletin
6. ILA Bulletin
7. Indian Librarian
8. International Library Movement (formerly Indian Library Movement)
9. Journal of Library and Information Science.
10. Libra
11. Library Herald
12. Library Review
13. Library Science with a Slant to Documentation
14. Lucknow Librarian
15. National Librarian

Foreign

1. FID/CR Newsletter
2. International Classification
3. International Library Review

Though no effort has been spared to include all the issues of the aforesaid journals, yet it is feared that some of them might have eluded this investigator due to a variety of reasons. An all comprehensive coverage is, therefore, not claimed, though that has been the cherished goal.

BASIS OF ANALYSIS

After scrutinizing various issues of the journals included and a couple of others, entries were prepared on cards and classified according to the Dewey Decimal Classification (19th edition), and the subject headings assigned. Later, the entries were grouped under the following broad subject headings:

1. Library Classification (general)
2. Classification and Computer
3. Research in Classification
4. General Classification Schedules
5. Dewey Decimal Classification
6. Universal Decimal Classification
7. Colon Classification
8. Fundamental Categories
9. Notation
10. Connecting Symbols
11. Phase Relation
12. Rounds and Levels
13. Array and Chain
14. Mnemonics
15. Classification Problems
16. Classification of Specific Subjects
17. Book Number.

The total number of articles contributed by the Indian and foreign authors in Indian journals on the above-mentioned subject divisions of library classification have been analysed. The analysis reveals the subject scatter, the divisions popular with the authors, yearly contributions of each of the periodicals or article scatter, Indian contribution vis-a-vis new developments in the subject of study, and so on.

ANALYSIS

A total number of 220 entries have been collected from 15 Indian and 3 foreign periodicals during the period 1971-80.

From Table 1 it is revealed that the maximum contribution in article form has been made during 1975. The figure of 45 (20.45%) articles is a bit more than double the yearly average of 22 articles. The obvious reason for such a large contribution is that the Third International Study Conference on Classification Research was held in Bombay, in 1975, the proceedings of which were published later. The second largest number of contributions (i.e., 41 or 18.63%) was made during 1976.This size of the output immediately after the conference year, and matching with it, was the result of the first centenary celebrations of the world famous Dewey Decimal Classification; and authors all over the world including India, made their contributions to the discipline through the professional media.

Besides, the output for the years of 1971, 1972 and 1973 is slightly higher than the yearly average. Thus, in all, for five years out of ten

Table 1

Year	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	Total
Number of articles	24	26	28	15	45	41	14	11	11	05	220
%	10.91	11.82	12.73	6.82	20.45	18.63	6.36	5	5	2.27	

covered, contributions are close to or more than the yearly average; while for the remaining five years i.e., for 1974, 1977, 1978, 1979, and 1980 the contributions are considerably below the average mark. The maximum contribution is 45 articles for the year 1975, it is only 5 (2.27%) for 1980, the minimum figure during the entire decade of 1971-80.

Another visible trend is the general decline in the contributions in the second half of the seventies. For the first five years (1971-1975) a total of 138 articles are published, while for the subsequent period of five years (1976-1980) the number of articles dwindled down to 82 only. This decline is sharply in contrast with the increase in the number of new LIS journals, establishment of new LIS departments at the university level, and subsequent increase in the strength of the faculty, number of working professionals, etc.

In Table 2, the yearwise contributions made in the subjects identified earlier serving as the basis for this analysis are presented. It reveals that the maximum number of articles have been published in various journals on library classification in general. Entries on this area were prepared from almost all the periodicals covered for the study. The second largest contribution is on the Dewey Decimal Classification system, the quantitative output of which stands at 47 articles. About half of these are published in one single year of 1976 which was celebrated as the centenary year of this classification scheme all over the world. It was followed by 34 articles on classification of specific subjects. Interestingly, most the research articles on this topic are published in only one periodical, namely, *Library Science with a Slant to Documentation,* and most of the authors are associated with the DRTC.

The topic 'classification problems' gets the fourth place with 18 articles written on it. However, these contributions are the production of first three years, 1971 to 1973, and no article has been reported in periodical literature thereafter upto 1980.

On Ranganathan's Colon Classification 13 articles are published during the seventies, but many more are published on such aspects of Colon as 'Fundamental Categories', 'Notation', 'Mnemonics', etc. The third classification scheme besides Dewey and Colon, on which is written in Indian periodicals, is the Universal Decimal Classification. However, only 7 articles are published on this scheme, five of which are produced in 1975 only and, unfortunately no more paper appeared in the periodical literature covered from 1976 to 1980. One reason is that this scheme is not popular in Indian libraries.

There are many topics of which not more than one article each is published; while on some others only two articles each have been published during the period of study.

It may, however, be pointed out that during seventies there has been shift in emphasis on classification in comparison to the contributions during 1950s and 1960s. The authors concentrated more on the theoretical aspects of Colon Classification, while now this emphasis, though continues, is certainly on the decline. This is further clear from the Table 2 that some new topics which have attracted the attention of the Indian authors during the seventies are 'Research in Classification' and 'Classification and Computers'. It may, however, be pointed out that though the Third International Study Conference on Classification Research was held in Bombay in 1975 where thesauri construction, indexing techniques, computer applications, etc were discussed, yet these themes do not seem to have evoked great interest among native professionals.

It is regretted to note that hardly any empirical studies regarding the use of various classification systems in Indian libraries is made. There is also lack of basic research using quantitative data to know the future patterns, which, however, is the need of the time. With the exception of the DRTC, no other body or individual is paying required amount of attention towards the new trends in classification which, according to Dahlberg[2] include: (1) resurveying of the totality of knowledge and bringing about compatibility between existing classification systems and thesauri; (2) understanding the elements of classification systems as concepts and units of knowledge through the analysis of which conceptual relationship are determined; (3) knowing that classification and indexing are contemporary activities.

AUTHOR SCATTER

Table 3 provides the information about the contributions made by the single authors, joint authors, title entries, etc. The break up is given in chronological sequence.

Table 2: Subject Scatter

S.No.	Subject	Year 1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	Total	Ranking
1.	Library Classification General	5	1	4	5	22	15	2	3	5	2	64	1
2.	Classification and Computer	-	2	-	-	1	-	-	-	-	-	3	8
3.	Research in Classification	2	-	-	-	4	-	-	1	-	-	7	6
4.	General Classification Schedules	5	2	-	-	2	1	-	2	-	1	13	5
5.	Dewey Decimal Classification	1	1	3	4	3	22	6	4	1	2	47	2
6.	Universal Decimal Classification	1	1	-	-	5	-	-	-	-	-	7	6
7.	Colon Classification	-	1	2	4	2	2	2	-	-	-	13	5
8.	Fundamental Categories	-	-	-	1	-	-	-	1	-	-	2	9
9.	Notation	-	2	-	-	-	-	-	-	-	-	2	9
10.	Connecting Symbols	-	-	-	-	1	-	-	-	-	-	1	10
11.	Phase Relation	-	-	-	-	-	-	-	-	1	-	1	10
12.	Rounds and Levels	-	-	1	-	-	-	-	-	-	-	1	10
13.	Array and Chain	-	-	-	-	-	-	-	-	1	-	1	10
14.	Mnemonics	-	1	-	-	-	1	-	-	-	-	2	9
15.	Classification Problems	3	4	11	-	-	-	-	-	-	-	18	4
16.	Classification of Specific Subjects	7	9	6	1	5	-	4	-	2	-	34	3
17.	Book Number	-	2	1	-	-	-	-	-	1	-	4	7
	Total	24	26	28	15	45	41	14	11	11	5	220	

Of the 220 entries included, 165 (75%) are written by single authors only, while the number of articles written by two authors is 30; and only 16 articles have been produced by three or more authors during 1971-80. Thus only about 21% contributions are made by two or more than two authors during 1971-80; while about 4% entries have no authorship and hence are placed under their respective titles. It can be concluded that the concept of team research is not popular among the Indian authors in the area of library classification.

FOREIGN AUTHORS

As seen in Table 4, during 1971-80 a total of 44 articles have been contributed by foreign authors with an yearly average of 4.4 articles. The foreign authors' contributions is 20% of the total literature produced on library classification. However, the maximum contributions (34) have been reported by single authors here as well.

Another feature of the foreign contributions is that maximum articles have been contributed during the Third International Study Conference on Classification Research.

GEOGRAPHICAL SCATTER

In the present analysis it is revealed that the largest chunk of articles (about 64) has been published by the teachers and researchers working at Documentation Research and Training Centre (DRTC), Bangalore. Besides, another 20 articles have been written by the librarians, teachers, etc., based at Bangalore. Calcutta, though way behind Bangalore, occupied next place by producing about 20 articles on various aspects of library classification. Another important geographical area is Delhi wherefrom the professionals have contributed about 10 papers as reported in various Indian journals.

If the contributions made by the foreign authors is separately taken into account, as referred to in Table 4, we are left with about 60 articles only which are published by working librarians, LIS teachers, etc., from all over India except Bangalore, Calcutta, and Delhi. It is noted that some articles emanate from such places as Jaipur, Varanasi, Ujjain, Nagpur, Chandigarh, Lucknow, Madras, Amritsar, etc. Though almost every university, out of about 130 in India, has its own university library with

Table 3: Author Scatter

Authors	Years										
	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	Total
Single	19	16	24	10	32	32	10	9	8	5	165
Two	5	4	2	-	8	5	2	1	3	-	30
Three or more	-	6	2	-	3	3	1	1	-	-	16
Title	-	-	-	5	2	1	1	-	-	-	9
Total											220

Table 4: Foreign Authors

Authors	Single	Two	Three of more	Total
Number of articles	34	7	3	44

professionally qualified staff, besides about 55 LIS departments at the university level, yet as much library literature is not being poured out as it should have been.

ARTICLE SCATTER

All the 220 contributions have not appeared in the periodical literature form alone. In the 15 Indian LIS journals included here a total number of 159 articles on library classification have been published during the decade 1971-1980. This works out to about 72.27% of the total articles covered in the survey.

Further, the three foreign journals included in which Indian authors have published their contributions on the subject of study, cover only 3.18% of the total.

Besides, many authors have contributed their articles in some books also which have been compiled for different purposes from time to time. The total number of such articles stands at 54 (24.55%). In this category the maximum contribution of 36 articles is made on the occasion of the Third International Study Conference on Classification Research.

Only two articles could be traced to have been contributed to foreign published books; while another two contributions made to the world famous *Encyclopedia of Library and Information Science,* edited by Allen Kent et al. are also included.

The journalwise aritcle scatter is presented in Table 5.

As reported above the maximum number of articles have been published in *Library Science with a slant to Documentation founded* by S.R. Ranganathan in 1964. Its contribution stands at 60 articles (27.27%) during the ten year period covered. It is followed by 28 articles in *Herald of Library Science* started by Prof. P.N. Kaula in 1962. Indian National Scientific Documentation Centre's *Annals of Library Science and Documentation,* the oldest surviving journal, has published only 11 articles during 1971-80; while 15 are published in the *Annual Seminar* of the DRTC. Another old journal *Indian Librarian* (ceased publication in 1982) stands fifth with 10 published articles to its credit.

CONTRIBUTIONS IN BOOK FORM

During the period under study, a total number of 21 books have been brought out in India. As revealed in Table 6, as many as 11 books are published on theoretical foundations of library classification. At least four books have been brought out on the practical aspect of classification, while two books are published on both theory and practice of the subject. Again, three books are written on author number, which is an important part of art and science of classification. During the seventies, at least one Ph.D. thesis has been produced at the Panjab University, Chandigarh. The researcher has extended the schedules of Dewey Decimal Classification (18th edition) in the areas of Indian philosophy, Indian religions, Indology, etc. This is an important contribution in this area as the schedules of DDC lack in detail of these subjects.

The foreign scholars have also contributed in the production of two books as a result of their lectures at the DRTC, Bangalore. Dr. I. Dahlberg delivered lectures on *Ontical Structures and Universal Classification,* published in 1978; while E. Wahlin's topic was *Research on Classification Systems,* published in 1979. This is quite a significant contribution to the existing body of literature on classification.

Another booklet was produced, also as a result of lecture, by Sh. Girja Kumar, former Librarian, Jawaharlal Nehru University, New Delhi, who delivered 'Ranganathan Memorial Lecture' at Vikram University, Ujjain in 1975.

One of the books is the outcome of an international conference, referred to earlier, held in Bombay in January 1975, the proceedings of which were published later in book form in 1979.

Another book on classification is produced a result of a seminar organised by the DRTC, Bangalore in 1977.

Yet another important document produced is indeed a report prepared by M.A. Gopinath of DRTC and submitted to the FID/CR Committee. It deals with classification research in India conducted during 1968-73. It is also published by the DRTC, Bangalore in 1974.

Dr. S.R. Ranganathan had published his *Preview* of the 7th edition of *Colon Classification* in 1971, and it was also published by the DRTC.

From the above, it becomes quite clear that the DRTC is the only institution contributed immensly to the field of library classification through publishing at least five books, by way of organising lectures, seminars, talks, etc.

Table 5: Article Scatter

S.No.	Name of Journal	Number of articles
	Indian	
1.	ALIS Bulletin	1
2.	Annals of Library Science and Documentation	11
3.	DRTC Annual Seminar	15
4.	Herald of Library Science	28
5.	IASLIC Bulletin	7
6.	ILA Bulletin	1
7.	Indian Librarian	10
8.	International Library Movement	10
9.	Journal of Library and Information Science	4
10.	Libra	1
11.	Library Herald	4
12.	Library Review	2
13.	Library Science with a slant to Documentation	60
14.	Lucknow Librarian	2
15.	National Librarian	3
	Foreign	
1.	FID/CR Newsletter	5
2.	International Classification	1
3.	International Library Review	1

Table 6: Subject Scatter - Books

Subject	Classification (Theory)	Classification (Practice)	Classification (Theory & Practice)	Author/ Book Number	Ph D Theses	Total
Number of Books	11	4	2	3	1	21

It is thus making efforts to fulfil one of its aims for which it has been set up.

CONCLUSIONS

This analysis reveals that Indian authors have shown a lack of interest in a number of topics such as, Research in Classification, Universal Decimal Classification, Notation, and many concepts of Colon Classification scheme like Fundamental Categories, Array and Chain, etc. Data in Table 2 reveal the dearth of literature published in these and other recent topics during 1971-1980. Though there have been occasional discussions about the role and need of 'Research in Library Classification' yet not much efforts have been made by the teachers in LIS as well as librarians to conduct research in this area.

In view of the latest developments, as recorded earlier on library classification, the Indian contribution is certainly not in tune with these developments. There is need, therefore, to devote more attention to these areas in the years to come.

As expected, the maximum number of articles as well as books have been published on the general area of library classification. Articles in periodicals only have contributed about 29.1% of the total articles covered.

The maximum number of articles have been published in the year 1975, while the minimum number of 5 articles were reported in the professional journals in the year 1980.

The number of articles during the first five years (1971-75) is much higher (138) than that (82) of the succeeding five years (1976-80). This is in spite of the fact that the number of LIS journals also increased in the second half of the seventies as also the professional manpower.

Single authors dominate the scene of contributions working out at 75% of the total output.

During all these years foreign authors have been quite active and have published 20% of the total articles thereby registering a significant contribution.

The maximum number of articles appearing in various professional journals have emanated from Bangalore followed by Calcutta and Delhi. Other geographical areas are not as significant from this point of view.

In conformity with this conclusion, it is also noticed that the maximum articles on library classification are published in *Library Science with a slant to Documentation* published from the DRTC, followed by the *Herald of Library Science*. Similarly, maximum books have also been published by the DRTC, thus making a significant contribution to library classification. This speaks volumes of its activity on this field quite in conformity with its set goals.

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ERRATA:

1. In Annals March-June 1985 Vol. 32(1-2) p.41 the name of joint author should read S.H.K. Reddy and not S.K. Reddy.
2. In Annals Sept-Dec 1985 Vol. 32(3-4) on p.93 the name of author and joint author should read M. Mahapatra & S.K. Musib respectively.

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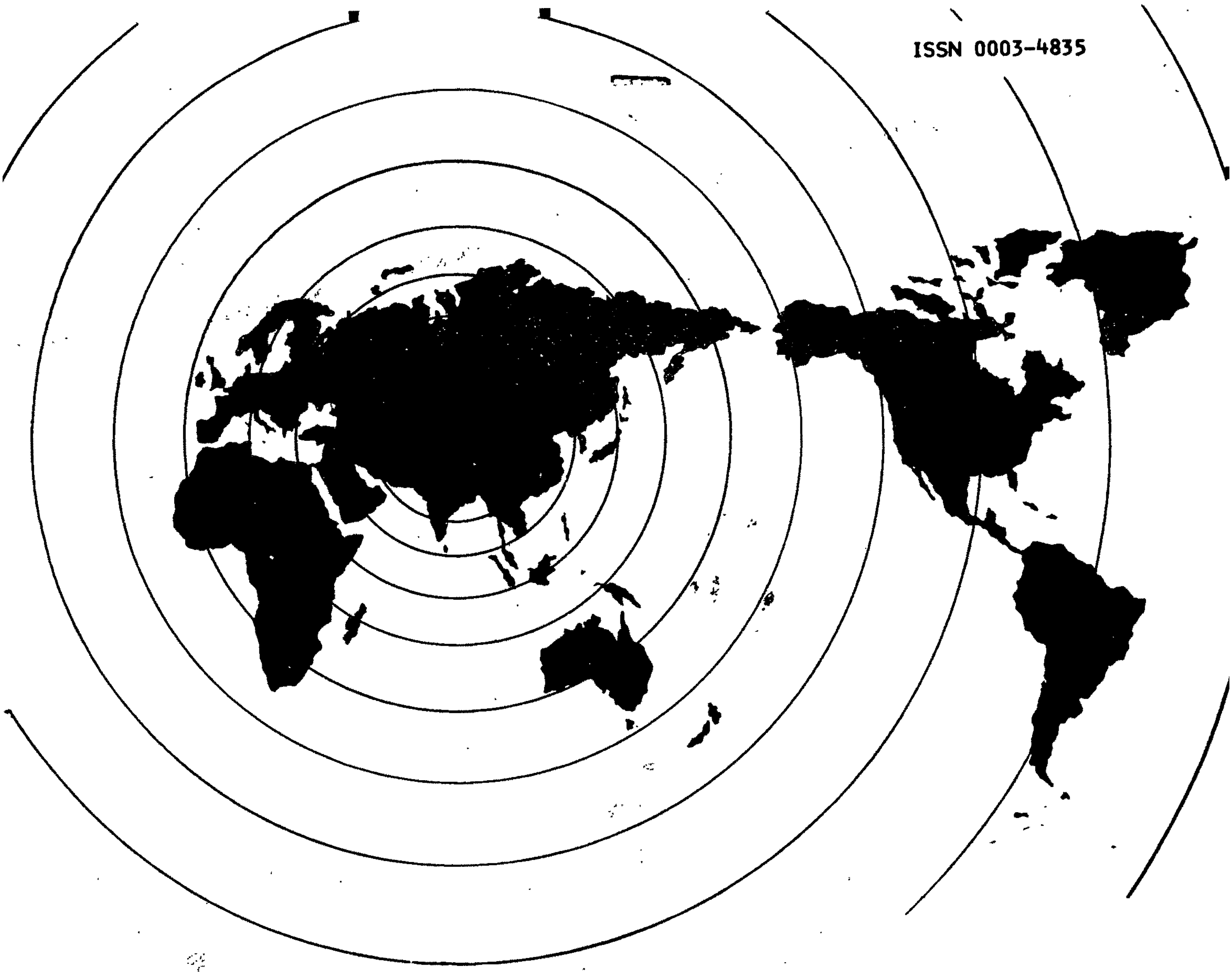

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INDIAN CONTRIBUTIONS IN BIBLIOMETRICS 1958-1984: A REVIEW

B.K. SEN
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Reviews 191 contributions showing the growth pattern, subjectwise activity, most productive journals and authors in the field.

INTRODUCTION

From the evidence available to us, it appears that the bibliometric studies in India started with the publication of an article by S Dutta and T S Rajagopalan in 1958 [31]. However, it may be noted here that the term librametry was coined by Ranganathan in 1948 during a discussion in Aslib Conference held in Lamington Spa (Aslib Proc. 1949, 1, 102), and the term was used more or less in the same sense of bibliometrics in India for quite sometime.

Bibliometric studies in India took a firm root in 1963 when a seminar was organised by DRTC on Documentation Periodicals and quite a few papers were presented in the conference including foreign ones. Eversince, the studies have been continuing. During the period of the last 27 years, about 200 papers have been published on the coverage and overlapping of literature, ranking of periodicals, use of literature by scientists and others, testing of various bibliometrical laws and so on. A survey of the studies conducted is long overdue to find out what has already been done, how they have done, what remains to be done, whether there is some gap in our studies etc. Hence, this study.

SCOPE

The study covers all published contributions on the subject made by Indians residing in India and abroad. Articles by foreign authors published in Indian journals have been excluded. Such contributions that are not purely bibliometric in nature, but have relevance to bibliometrics have also been included.

GROWTH

Table 1 shows the yearwise output of literature in India starting from 1958 in which year only one article was published. Afterwards, Ranganathan's bibliometric analysis of the books published by South Indian Saiva Siddhanta Works Publishing Society appeared in 1961 and in 1963 DRTC conducted seminar on Documentation Periodicals in which nine papers by Indian authors were presented. One more paper was published in the *Annals of Library Science,* and a book appeared on the growth of Indian medical periodicals. The Seminar practically laid down the foundation of the bibliometric studies in India. As a result, bibliometric studies continued uninterrupted in India and are still continuing, even though the number of articles per year did not go beyond five till 1969. The number of articles went to 14 in 1978 because of another DRTC seminar on the subject. From which year, however on an average 13 articles are being published per year. About 200 articles are published per year on the subject in the world. As such India's annual contribution to the subject is of the order of 6% to 8%.

BIBLIOMETRICS - STUDIES ON VARIOUS FACETS

Guha [42] in his book entitled 'Documentation & Information' dealt with bibliometrics in a chapter called Bibliometrics and discussed various aspects of the subject. Rao [134] also discussed in his book, various laws like Bradford's law, Lotka's law and Zipf's law forming part of bibliometrics, and some studies conducted by him.

Dutta and Rajagopalan [31] surveyed citation practices followed by 200 Indian and

Table - 1 : Yearwise Distribution of Articles

Year	Nos. of article/s
1958	1
1961	1
1963	11
1964	2
1965	5
1966	5
1967	4
1968	1
1969	5
1970	10
1971	11
1972	10
1973	6
1974	12
1975	6
1976	4
1977	6
1978	14
1979	9
1980	17
1981	9
1982	9
1983	17
1984	16
	191

foreign periodicals. Observing great diversity in existing practices, the authors emphasised the need for standardisation. Jadhav [68] also discussed the need for standardisation of citations and highlighted the efforts made by ISO, BSI & ISI in this direction. Mitra [89] reviewed the role of citations in present-day context. Subramanyam [175] discussed the significance of citations. Ghosh [38] analysed the information content of titles in contraception literature.

CITATION ANALYSIS

Citation analysis has been discussed by Malwad [83], Sharma [165], Gupta [49,53], Mohan Roy [90], Sharma et al [164], Arunachalam [4], Kartikeyan [72], Verma [183], and Dhawan [27]. Sharma [165] described the basic concepts of citations, important applications of citation analysis and its drawbacks, and gave suggestions for their elimination. Mohan Roy [90] showed how the technique of citation analysis can be employed to study the growth and structure of literature, and for library management, and Arunachalam [4] discussed how citation analysis can be used as a sociometric tool. Sharma et al [164] showed how electron lattice scattering technique for citation analysis can be used to measure the impact of research papers. Gupta [49] dwelt on the various applications of citation analysis which have implications on the structure and dynamics of science. In another paper, Gupta & Nagpal [53] reviewed some of the important developments in the application of the technique of citation analysis. Kartikeyan [72] as well as Verma and Murthy [183] studied the citation pattern by specialists, the latter studied the pattern in a thesis. Dhawan et al [27] discussed some points of citation analysis vis-a-vis use study. Roy et al [139] attempted to improve the total citation count from first author count and from total papers. Malwad [84] discussed various aspects of journal ranking through citation analysis and Prabha [107] revealed some aspects of citation behaviour through a pilot study in business administration.

Bradford's law of scatter has been studied in a number of papers. Reddy [137] studied the law dividing a subject into three developmental stages - theoretical studies, experimental studies and applications; and found that this type of division of a subject significantly influences the scatter.

Using citation analysis technique Gupta[52] investigated the networking of papers basing a sample of papers published in *Geliotekhnika* and found that co-citation is the most suitable technique for networking. Sen & Gan [146] in their paper provided a mathematical extension to the idea of bibliographic coupling. It is also a known fact that many papers for some reason or the other are not cited. Ghosh [40,41] in his two papers studied this very phenomenon of uncitedness of papers basing papers published in *Nature* and *Journal of the American Chemical Society*.

Use Pattern of Documents

Specialists use various types of documents in their pursuit of knowledge. Rao [129] tried to find out the use pattern of documents by specialists employing the method of citation analysis, questionnaire and interview. Mitra [88] studied the use pattern of literature in 14 different disciplines analysing 26 Indian journal citations. Maheshwarappa & Prakash [81] and Guha [45] studied the use pattern of literature by botanists and European sociologists respectively. Amba [2] on the other hand investigated the use of patent literature. Luthra [79] made a comparative study of the use of *Chemical Abstracts* and *Index Medicus.*

Kartikeyan & Guha [73] studied the impact of *Referativnyi Zhurnal* on the use of English literature by Soviet scientists and found the impact to be positive. Ghosh [35], Malwad [83] and Sharma [166] all studied various facets of citation indexes, and Gera [34] discussed the efficacy of *Social Science Citation Index* in the retrieval of information.

BIBLIOMETRIC STUDIES AND PERIODICALS

Several bibliometric studies have been conducted with periodicals. Gupta [64] and Rao [133] both studied the obsolescence and utility factors of periodicals. Rao [132] also studied the growth and obsolescence factors of periodicals relating to sociology. Malwad [84] discussed the pros and cons of the ranking of journals through citation analysis. Rahman et al [112] and Arunachalam [6] studied the various facets of Indian scientific journals. Arunachalam & Markanday [8] conducted a bibliometric analysis of 95 English language scientific journals of Australia, Canada, India and Israel and found that most of the journals are local level journals; their cognitive contribution to mainstream of international research activity is low and they cite more than they are cited. Moreover these journals cite much greater proportion of older references than international journals, indicating their preoccupation with problems of low current relevance. Guha et al [44] in their incomplete study published in five instalments enumerated the reasons that lead to the change of titles in periodicals. Dutta [30] discussed various points relating to evaluation of scientific periodicals, and Subramanyam in his three papers dwelt on environmental research journals [180], reviewed the current trends and future prospects of scientific journals [179] and considered various criteria for journal selection [177]. Dhawan et al [28] also presented a model for journal selection. Kaula [74] dealt with the periodicals in library science. Gupta & Nathan [54] isolated factors that adversely affect the quality of periodicals in developing countries. Sengupta et al [161] discussed the role of bibliometry in journal selection.

BIBLIOMETRIC STUDIES RELATING TO VARIOUS SUBJECTS

Library and Information Science

Though most of the bibliometric studies in India have been conducted by librarians and information scientists, yet the bibliometric studies on library and information science are few. Neelameghan [99] has discussed at length the expressions of time in information science and their implications. Chakraborty et al [23] found out the giants of library science by analysing the citations in the different editions of the *Handbook of Special Librarianship & Information Work (Aslib)* on the basis of citation score, S R Ranganathan topped the list of authors. Das Gupta [25] conducted a bibliometric study of writing by and on Ranganathan and published till 1961. Kundu [77, 78] analysed the citations in the *Annals of Library Science* (afterwards *Annals of Library Science and Documentation)* vols. 1-22 and found out the 14.9% of the citations are self citations, *Annals of Library Science* (afterwards *Annals of Library Science & Documentation*) has been cited most, and *American Documentation* is the most cited foreign journal. Singh [168] analysed the contribution in library and information science in India during 1971-82. Arunachalam [5] emphasised the need for introducing information technology, user education, research in STI system in India. Bhattacharyya [17] highlighted the trends in librarianship in India.

User study is drawing serious attention of librarians and information scientists for quite sometime. Srinivasan [170] in his paper dwelt on the influence of user studies on the improvement of documentation services in developing countries.

The citation as a mean of literature search has been studied by Ghosh [39] as well as Reddy [136]. Ghosh conducted an experimental study of searching literature using the method of citation mapping. The author opines that the technique will be useful in the compilation of bibliographies on microsubjects.

Social Sciences

Kaula presented some of the characteristics of social science information from Indian user's point of view including bibliographical form, core periodicals, publication age of information material, dispersion of periodical literature, and their seepage. The use of literature (a) by European sociologists has been studied by Guha [45], and (b) by research scholars in political science and economics has been studied by Verma & Murthy [184]. The quantitative and collaborative trends in American sociology research have been examined by Patel[103,104]. Parbha [107] conducted a pilot study to probe into the citation behaviour in business administration literature.

Survey Analysis

There are three papers on the subject, in which the documents on survey analysis, and its development and structure have been dealt with by Seetharama [141,142]. Rao [130] studied the dispersion of documents on survey analysis.

Economics

Goil [187] studied the coverage of Indian documents on economics by *International Bibliography of Economics, Index of Economic Journals, World Agricultural Economics & Rural Sociology Abstracts,* and *Journal of Economic Abstracts* during 1952-1960. Rajan [188] examined the scattering of Indian documents on economics in 25 Indian and 53 foreign journals of 1959 & 1960 and found that 97.5% of the documents were published in Indian journals.

Physical Education

Basing the citations in *Research Quarterly,* Rao [127] prepared a ranked list of periodicals on physical education.

Science & Technology

Indians have been publishing research contributions in foreign journals eversince Indian scientists started working on modern science. To what extent Indian scientists publish their contribution abroad was studied for the first time by Guha et al.[43] basing 750 periodicals covered by *Insdoc List* in 1964. Of the 1406 articles published in foreign journals, 364 articles belonged to chemistry, 323 articles to physics, 175 articles to medicine, and the rest to other fields. The largest number of articles were published in *Physical Review* (75), *Nuovo Cimento* (50) and *Nuclear Physics* (45). Mehrotra and Lancaster (86) also carried out a similar study basing the publications listed under India in the Geographic Section of Corporate Index of the *Science Citation Index* of the year 1979-81.

During 1963-65, a few studies were conducted to find out the extent of coverage of Indian contributions in the well-known foreign abstracting & indexing services. Sen [144] presented a summary of some of these findings in his review paper. In another paper, Sen [143] studied the citation of Indian contributions in Nobel Lectures (Physics 1901-62; Chemistry 1901-62, and Medicine 1922-62), and found that 21 Indian scientists were cited in Nobel lectures - 12 of them by C V Raman; M N Saha was the first scientist to the cited (cited by W H Nerst 1920) and S N Bose & H J Bhabha were the last to be cited (both were cited by H Yukawa in 1949). Ranganathan [189] discussed the problem of language barrier in the coverage of documents by abstracting periodicals and suggested remedial measures.

Ranga Rao [125] studied research activities in India basing the publications noticed in the *Indian Science Abstracts* (Vol.1, 1965) and presented the distribution of papers according to institution, subject and author. Pruthi & Nagpaul [108] studied the pattern and role of communication in R&D. Arunachalam [5] dealt with information aspects of S&T and advocated for the introduction of information technology, user education and research in S&T information.

Naranan [96, 97] studied Bradford's Law and power law relation in science bibliography. How *Referativnvi Zhuranal* (RZ) has influenced the Russian scientists in the use of non-Russian literature has been studied by Kartikeyan and Guha [73], and it is found that there is an increase in the number of English references per paper as well as an increase in the number of English periodicals cited by Russian scientists after the advent of RZ. Rao [131] studied the distribution of scientific productivity vis-a-vis social change and found that a negative binominal distribution fits scientific data better than many other distributions such as geometric, logarithmic, zeta, etc. It is shown analytically that the negative binomial distribution describes a pattern of scientific productivity under the "success breeds success" condition in a wide variety of social circumstances.

Subramanyam [174] reviewed eight research collaborations and emphasised the need for refining the method of defining and assessing collaboration and its impact on the organisation of research and communication in science.

History of Science

There is only one contribution in the field, wherein Mitra [89] discussed the problem related to evaluation and assessment of continuity of scientific ideas in history of science.

Mathematics

Three bibliometric studies on mathematics have been carried out in India, Rajagopalan et al [117] studied the extent of coverage and speed of reporting of Indian mathematics literature in *Mathematical Reviews* and *Bulletin Signaletique* taking the articles covered in the *Bibliography of Scientific Publications of South and South East Asia* as the base. *Mathematical Reviews* has covered 55.2% and 50.6% and *Bulletin Signaletique* 50.5% and 36% of the Indian mathematics literature of the years 1961 & 1962. The *Mathematical Reviews* has covered the literature of 1961 & 1962 in 48 and 28 months, and *Bulletin Signaletique* has covered in 16 & 12 months respectively. Peter & Rajagopalan [105] as well as Basak & Das [13] studied the scatter of Indian contributions on mathematics in Indian and foreign journals. The former authors took *Mathematical Reviews* 1965 as the base, and the latter took *Mathematical Reviews* 1977 as the base. Basak & Das also compared the results of 1965 studies with their study to find out the change in trend.

Physics

A dozen bibliometric studies have been published in this area showing the interest bibliometricians are taking in physics. The first paper by Rajagopalan & Sen [116] studied the extent as well as the speed of reporting of Indian literature in *Physics Abstracts*. The *Physics Abstracts* has covered 65.5% & 57.4% of Indian literature of 1960 & 1961 in about 2 years time. Kapoor [70] as well as Rangarajan & Gupta [123] studied the scatter of Indian physics literature in the periodicals of different countries. Gupta [48] as well as Dhawan & Yadav [29] examined the type of documents cited by Indian physicists. Gupta [55] based his citation study on a single physicist, i.e. S. Chandrasekhar, the 1983 Nobel Prize winner for physics, and found that 401 works of Chandrasekhar have been cited 10,359 times during 1965-80 and out of 401 contributions only six have accounted for 53% of the citations. Rangarajan et al [124] provided a bird's eye view of the researches going on in the field of physics in India. Arunachalam et al [7] conducted a bibliometric analysis of Israeli contributions in physics covered in 10 major sections of *Physics Abstracts* (Jan-June 1977) and found that the contributions in this area are usually published in the high ranking journals of USA, UK & the Netherlands. The contributions are productive in condensed matter physics; nuclear, atomic and molecular physics. In chemical physics, they seem to be specially strong. A few contributions in the areas of special theories, interaction models, particle systematics and biophysics were found to have high impact factor. The contributions in nuclear physics are not well-cited.

Rangarajan & Bhatnagar [122] also took a very narrow area, i.e. Mossbauer effect, as the subject of study. Literature published on the subject for about two decades from its discovery has been studied. In respect of literature output USA came first, followed by USSR, India ranked 7th. Arunachalam & Singh [10] analysed the citations received during 1970-81 by 255 randomly chosen documents on superconductivity published in 1969-70, and found that 85% of the contributions were in English, USA led the field followed by USSR & Japan. However, Soviet & Japanese contributions were cited less. 22 US contributions received more than 25 citations during the period. Of the papers included in the sample, three papers received more than 100 citations each, 20 papers received between 30 & 100 citations and 63 papers received no citation. The distribution of the citation to the 23 highly cited (at least 30 times) papers as a time series shows a distinct pattern of an initial stage of rapid rise in citations per year followed by a plateau & a subsequent decline. Verma [182] studied the trends in nuclear research in India basing the literature covered in ISA in five years, and found that over 50% of literature is published in four journals and BARC is the topmost contributor. Nagarathna [94] studied the use of documents by nuclear physicists.

Chemistry

There are eleven bibliometric studies devoted to chemistry, which is slightly less in number compared to physics. The first paper by Krishnan & Surendar Mohan [76] studied the coverage of Indian documents in chemistry and chemical technology. This study revealed that *Chemical Abstracts* covers about 90% of Indian documents within twenty four months. Rangra et al [126] studied the coverage of Indian literature on chemistry & chemical technology excluding metallurgy in *Referativnyi Zhurnal* (RZ) - *Khimiya* basing the literature reported in *Indian Science Abstracts* (V. 1, 1965), and found that only 31% of literature has been covered by RZ.

Ranking of chemistry periodicals has been studied by Singh [167] from the Indian scientists' point of view basing the citations in six issues of *Indian Journal of Chemistry* Vol.8 (1970). Mohinder Singh [91] has shown how the ranking of chemistry periodicals has undergone change during 1967 & 1976.

Bhattacharyya [186] studied the coverage of documents on physical chemistry in *Chemical Abstracts, Bulletin Signaletique - Chimie,* and *Referativnyi Zhurnal - Khimiya* of 1956, 1959 & 1961.

Two studies have been made on electrochemistry. George & Parthasarathy [33] studied the scatter of documents on electrochemistry among 592 periodicals. 127 periodicals carried 90% of the documents on the subject. Indian contributions to world literature of electrochemistry have been studied by Arunachalam et al [9] basing the *Chemical Abstracts - Section* 77(1974). Journal preference of Indian authors, major individual and corporate contributors and the impact of the above papers have also been studied.

Sharma & Saxena [163] examined the refereeing patterns of *Indian Journal of Chemistry* & the *Journal of the Indian Chemical Society* to understand their interactions with chemistry journals. Anand[3] analysed the communication of the *Journal of the Indian Chemical Society* 1979 and found out among others the trend of publications by Indian chemists and the use of journals by them.

Ghosh & Neufeld[41] studied the uncitedness of articles in the *Journal of the American Chemical Society.* Luthra [79] studied the coverage, bibliographical data, indexes, time lag, cost & use of *Chemical Abstracts* in comparison with *Index Medicus.*

Earth Sciences

Earth sciences have accounted for as many as 16 bibliometric studies. Majority of the contributions have come out from two authors i.e. D K Gupta, who has contributed as many as eight papers, followed by A R Chakraborty, whose tally is four.

Gupta, in four of his papers [58,59,60,62] presented the results of the analysis of 642 citations received during 1968-79 by a single paper of Le Pichon on sea flow spreading published in 1968 in the *Journal of Geophysical Research.* On the basis of the analysis, the author has found out the periodicals citing articles, identified the peers and specialists on plate tectonics and sea-floor spreading, showed how the transmission of the idea contained in Le Pichon's paper followed the epidemic pattern, prepared a ranked list of journals, and applied Bradford's law of scatter. In another paper Gupta [56] analysed the citations on various papers of Le Pichon published during 1965-79 and found out the heavily cited papers of Le Pichon. Gupta [57, 63] also analysed the citations of *Geophysics* 1980 volume as well as *American Association of Petroleum Geologists Bulletin* 1970 volume. In the case of geophysics and petroleum geology the average half life of the literature was found to be 9.4 years, and 5.7 years respectively. A bibliography on computer-based storage and retrieval of geoscience information comprising 336 items were also analysed by Gupta and rate of growth etc. was studied [61].

Chakraborty in his four papers [19-22] dwelt on various aspects of geological literature. Analysing the representative data of the last four decades, the author observed a growing tendency towards team research [22]. Scatter of Indian geological literature in Indian and foreign periodicals has also been studied and it is found that about 90% of the literature is covered in Indian sources [21]. A citation pattern based on the chronological distribution has been studied in the field of marine geology. The pattern indicates in order to cover literature upto certain period, periodical upto which year should be procured [19]. Chronological development of documentation activity in geological science in India has been traced which shows earliest documentation work in India was carried out in Geological Survey of India.

Raina [113] analysed a sample statistical data of the research output of Indian geologists and found out the time lag, citation pattern, geographical distribution of authors and their information needs. Kapoor [71] analysed the citations in the *Annual Review of Earth & Planetary Science,* Vol. 1-9, 1973-81 and prepared a rank list of 82 journals accounting for 76% of the total citations. Countrywise and subjectwise distribution of journals have also been provided. Nag [92] and Vaidyanathan [181] carried out bibliometric analysis taking the *Indian Journal of Earth Science* and *Journal of the Geological Society of India* respectively as the base.

Biological Sciences

Quite a good number of bibliometric studies have been carried on biological sciences in general as well as on its various branches. The credit for this mostly goes to I N Sengupta, who has contributed as many as 15 articles (13 singly & 2 jointly) in this area. Iyer [67] studied the scatter of Indian biological contributions in Indian and foreign journals. The contributions made by Indians residing abroad has also been taken into account. Sengupta [150, 156, 157] prepared a ranked list of biomedical periodicals from the Indian scientists point of view, and studied the factors responsible for changing the ranks of scientific periodicals.

There is only one study on anthropology, in which Rana [119] analysed the citations in 272 articles published in *Man in India* during 1970-79 and found that mostly books have been cited & most of the citations are more than 10 year old. Shalini & Raghavan [162] studied the scatter of literature in genetics.

On microbiology, there are two contributions, both of which are by Sengupta [147, 153], wherein the growth and development of the subject have been studied and a ranked list of periodicals prepared taking the *Annual Review of Microbiology* 1968-70 as a source journal.

Of the seven contributions on biochemistry, three are by Sengupta [151,158,159], wherein he studied the growth of biochemical literature, change in the ranking of periodicals, and offered a weightage formula to rerank biochemical periodicals. Rathore & Mishra [135] examined the usefulness of biochemical periodicals in India, and Bhat [14] studied how author abstracts have been treated by various abstracting services and found that most of the author abstracts have been published without any change.

Chandran [24] and Raina [114] both analysed the citations of the *Annual Review of Biochemistry* 1979 & 1983 volumes respectively from various angles. Raina attempted to establish the stability in the ranks of some important journals in biochemistry by comparing some ranked lists compiled earlier.

Because of environmental pollution, environmental research is continuously gaining ground all over the world. India is also no exception. In this perspective, Bhat et al [16] has studied the channels of publishing of research contributions on the subject. Subramanyam & O Pecko [180] dealt with environmental research journals.

Botany

There are two studies on botany in general. In one, Rahman & Malik [111] examined the trends of botanical research in India in 1960s, and in the other, Maheswarappa and Prakash [81] studied the literature use pattern of botanical research workers analysing the citations of some doctoral theses.

The study on phytomorphology by Maheswarappa [80] is based on the citations in *Phytomorphology,* Vol. 25-29 (1975-79). Analysing the citations, the author found out the heavily cited journals, geographical distribution of articles, obsolescence of literature, etc. Nagappa & Maheshwarappa [93] prepared ranked list of periodicals on plant physiology analysing the citations published in *Indian Journal of Plant Pathology* Vol.19 (1976)-22 (1979). Aulakh et al [11] studied the growth pattern and scatter of phytochemical literature 1976-80, and identified major journals publishing the literature and major institutions generating it.

Zoology

As far as bibliometric studies by Indians are concerned, zoology is a fallow area. Only one study on the subject has been noticed by us. The study by Ghosh [37] dwelt on the scatter of zoological contributions among 263 periodicals. 96 periodicals carried 90% of the contributions.

17%, 12%, and 9% of the contributions were published in USA, UK and Germany respectively.

Discoveries & Patents

There are two papers on discoveries [100,102] and one paper by Amba [2] on the use of patents, which has already been discussed. Both the papers on discoveries have been authorised by Neelameghan & others. One paper deals with the distribution pattern of discoveries, and the other studies discovery & rediscovery of antibiotics.

Medicine

Though in the realm of Indian scientific literature, medicine tops the list in respect of quantity of papers as well as the number of periodicals, yet bibliometric studies on the field are not many. We have encountered about a dozen papers, half of which has been contributed by Sengupta either singly or jointly. Hence, there is enough scope in this area also for bibliometric studies.

The growth of Indian medical societies and periodicals during 1780-1920 was studied in detail by Neelameghan [97a] which was updated by Sen et al [145] till 1965. In the same paper, the coverage of Indian medical literature in *Index Medicus* (IM) and *Excerpta Medica* was studied and it was found that ***Index Medicus*** and ***Excerpta Medica*** covered respectively only 38% and 13.5% of the Indian literature in 10 and 23 months, noticed in the ***Bibliography of Scientific Publications of South & South East Asia*** 1972. Vetal [185] studied the time lag in the coverage of Indian literature in the above mentioned services and argued for a local documentation list. Luthra [79] studied the coverage, bibliographic data, indexes, time lag, cost and use in ***Index Medicus*** in comparison with ***Chemical Abstracts***. Sengupta [152, 157] and Sengupta et al [161] have prepared ranked list of periodicals of medicine, which would help librarians in the better selection of periodicals. Neelameghan & Ranga Rau [101] studied the seepage of documents in medical electronics. The historiography of Indian medicine has been analysed by Neelameghan [98] for the period 1954-61, during which period Indian contributions have risen by 65% while foreign contribution by 30%.

Sengupta in five different papers [148, 149, 154, 155, 160] - the last one is a joint contribution, studied the growth of physiology, pharmacology and neurosciences literature and prepared ranked list of periodicals on all the areas.

Ghosh [38] studied the information content of contraception literature.

Engineering

The number of bibliometric studies in the field of engineering is few, despite the fact that we have quite a large number of engineering librarians. It is interesting to note that about half of the contributions in this field are from non-engineering librarians.

Analysing the papers of the Soviet periodical *Geliotekhnika* (Solar Energy Engineering) as well as citations in those papers, Gupta in his three papers [50-2] studied the internal and external connections of a research branch, networks of scientific papers discussed earlier, and also studied the citations on solar energy research in USSR. Roy [138] commented on the citation study of materials science department.

Nagpal et al [95] studied the trends in electronic engineering research in India in 1960s. The scatter of contributions in radio engineering have been studied by Gundu Rao [46] and Rao [128], and on antennas by Gundu Rao & Talwar [47].

Gupta et al [64] studied the active life of periodicals on structural engineering, and found that periodicals in this field lose their utility value after eight years.

In the three studies devoted to aeronautics and astronautics - a ranked list has been prepared by Bhat and Elisha Raju [15]. Garudadwajan and Murthy [32] applied Bradford law to obtain a fairly reliable estimate of core periodicals on aeronautics and related fields, and Mamadpalli [85] studied the publication channel, number of publications etc of NAL scientists as well as the reasons for their preferring particular journals for publishing their articles.

Agriculture & Agro-industries

Considering the output of Indian scientific literature, agriculture ranks second, next only to medicine. However, bibliometric studies on the field are not many. Hence, there is scope for good number of studies in the field.

Rajagopalan was the earliest to usher in bibliometric studies in this field in India. The extent and speed of coverage of Indian literature on agriculture, botany, zoology and animal husbandary as reported in the *Bibliography of Scientific Publications of South & Southeast Asia 1956-1962* was examined in the *Biological Abstracts, Bibliography of Agriculture,* and six CAB Abstracting services (i.e. *Soils & Fertilisers, Plant Breeding Abstracts, Horticultural Abstracts, Field Crop Abstracts, Animal Breeding Abstracts and Dairy Science)* in his papers [115, 118].

Quite a good amount of time is elapsed between the submission of a paper and its final publication in a periodical. Jain & Goyal [69] studied this very aspect in their paper. This seems to be the only study made in India on this aspect.

Phadnis & Sital [106] have presented a complete picture of agricultural research in India and an account of information facilities available to an agricultural scientist in India. Hadagali [65] and Deshmukh & Ashok Kumar [26] have compiled on the basis of citation analysis, ranked list of periodicals on agricultural economics, and soil science.

The impact of contributions of a single author in terms of citation count has been studied [55,56] in the case of S. Chandrasekhar and Le Pichon. Sinha and Bhatnagar [169] have conducted a similar study taking 68 contributions of Dr R C Sinha, an India-born plant pathologist settled in Canada.

Subbaiah [171-2] carried out two studies analysing the Indian contributions on grape research during 1901-1981 and weed research during 1950-1982. In both the cases, collaborative research was found to be predominant, and journals were the principal media of communication. In the case of weed research, conference proceedings have also been found to be important media of communication.

Hemasundar Naidu [66] prepared a ranked list of 31 core periodicals in poultry science analysing about 3000 citations appended to 33 theses and dissertations and 30 research papers.

There is only one study on fisheries. In this study by Ghosh [36], scatter of the literature emanated during 1958-62 has been examined and it has been found that 90% of the documents were published in 60 periodicals.

Food Science & Technology

There are four studies on the field, in which the role of India in the bibliographic organization of food literature in commonwealth countries has been studied by Sangameswaran & Gopinath [140], taking into account the literature output and its varieties, secondary services operating in the field etc. Indian literature pertaining to nuclear science & technology, agriculture etc is being inputted to international secondary service by various agencies. Ranganath et al [120] described the experience of food information input to international abstracting services & highlighted the usefulness of such activity.

A great deal of economy can be achieved in periodical acquisition provided periodicals are procured on the basis of their optimal use. Keeping this in view, a study was conducted by Raghavan & Shalini [110] with the periodical holding of CFTRI library & a ranked list was compiled. The scatter of literature in the field was found to obey Bradford's law.

Maheswarappa and Rao [82] conducted a study with the citations appended to three representative journals on the subject, one each from India, U.K. & U.S.A. and prepared a list of core journals. Obsolescence factor was also studied.

Other Technologies

There is one paper each on glass and ceramics, metallurgy, leather technology, and man-made fibre. Using Bradford's mathematical model and basing the citations of 346 titles abstracted in *Chemical Abstracts* 1970-71, Bhattacharyya [18] determined the scattering coefficient and core periodicals on the subject.

Nagarathna [94] studied the use of documents by metallurgists. Amba & Raghavan [1] studied the scatter of the journal literature on leather as reported in the *Chemical Abstracts* 1955-69. The scatter satisfied Bradford's law. Shah [190] studied the coverage of documents on man-made fibres in the *Chemical Abstracts* of 1950 to 1961.

Four papers are devoted to computer science journals and literature. Subramanyam [178] as well as Radhakrishnan and Kernizan [109] studied Lotka's law and computer science literature. Subramanyam [173, 176] also conducted bibliometric investigation of computer science literature and prepared a ranked list of core periodicals on computer science.

Linguistics

Analysing 3166 citations appended to 307 articles published in *Indian Linguists* (Vol. 32-41: 1971-80), Begum and Sharada [12] found that books are used more than journals. References are considerably concentrated on a few journals, and most of the references were from current journals.

PROLIFIC AUTHORS

Taking both singular and joint contributions into account, I N Sengupta is found to be the most prolific author with 15 contributions, followed by B M Gupta and D K Gupta (9 contributions each), K Subramanyam, (8 contributions), S Arunachalam, J S Ghosh and B K Sen (7 contributions each), A Neelameghan, I K R Rao and T S Rajagopalan (6 contributions each).

CORE JOURNALS

Annals of Library Science and Documentation tops the list with 57 contributions followed by *IASLIC Bulletin* (20 contributions), *DRTC Seminar* (19 contributions) and *Library Science with a slant to Documentation* (13 contributions). The score of 14 journals (Indian & foreign) ranges from 2 to 8. 16 Journals (Indian & foreign) have only one article to their credit.

DISCUSSION

Ranking

On an analysis of the studies made in our country, it becomes apparent that the largest number of studies were based on citation count and directed to the ranking of periodicals in various fields, application of Bradford's law, and determination of obsolence of literature. Ranking of periodicals has been done in all cases by the total number of citations, a particular periodical has received. This procedure does not lead to correct ranking because a periodical which is publishing more number of articles and coming out for a longer time will obviously be cited more number of times than a periodical of the same standard, but publishing less number of articles and coming out for a less number of years. As a result, new journals will always go down in the order because the total number of articles published in the journal is less, so also the citations. If a library wants to subscribe to journals on the basis of their ranking decided purely on the basis of count, almost always new journals will be axed, for which demands may be more in the library. Application of impact factor and other methods of ranking suggested by Eugene Garfield, as well as Sengupta's corrective formula for new journals will provide more realistic ranking. Sometimes, it is found that the authors have included titles in the ranked list of periodicals which have been cited just once or twice. It unnecessarily lengthens the table and creates problem for the publication of the article. The authors should judiciously fix the limit of citations for inclusion of periodicals in the list so that all important periodicals are included and the table does not become unwieldy.

In certain cases, where the scattering of articles on a subject are shown there it may be necessary to include periodical in the table even with one citation. Cases like this should be considered exceptional.

Sample

The sample taken for some of the studies is too small for any decisive conclusion. It is suggested that a sample of minimum 1,000 citations should be taken with exceptions in the following cases:

i) the citations study of a single article.
   In this case, citations to the article for a minimum period of five years should be taken in case their total number does not exceed 1000.
ii) the citation study of a single author.
iii) the citation study of a nascent subject. A minimum of 5 years of literature should be studied.
iv) the citation study of a single journal.

Here also, the citation for a minimum period of five years should be studied. In this case the citation connotes the citable items published in a journal, and not the citation appended to the articles of the journal.

Abstract

In the Soviet Union, the state-of-the-art publication coming out under the title of *Itogi Nauki* and *Itogi Nauki i Tekhniki* are completely based on the abstracts published in the *Re-*

ferativnyi Zhurnal. A review has to take into account all contributions published in various languages in the world. The reviewer, not in a position to handle literature in more than a few languages, has to depend on abstracts to ride over the language barrier. This is true for any reviewer in the world. Therefore, the abstracts should be informative enough for the purpose.

While writing this review, it was found that most of the abstracts were not providing the required information.

It is suggested that in the abstract of bibliometric studies based on various counts, the source document consulted should positively be mentioned along with volume nos/issues, the corresponding years, the total number of citations as well as the important findings.

From a bibliometric study, the ranking list of periodicals, the obsolescence of literature, the pattern of use of documents, authorship pattern, the countrywise, languagewise or yearwise distribution of articles can be determined, as well as Bradford's law can be applied and verified. As such these studies provide ample scope for spinning out several articles basing a single study. This tendency is quite prevalent in some Indian authors. We feel this is unethical and suggest that all the results of a single study should be published in a single paper.

Reporting of Indian Contributions in Foreign Secondary Services

To what extent and with which speed Indian scientific literature is being covered by the international abstracting and indexing services have been studied in several papers, and all the major services have been covered. However, most of the studies were conducted about two decades ago and more fresh studies can be undertaken to see whether there is any change.

Scattering of Indian contributions in Indian and Foreign Journals

The extent of Indian contributions published in foreign journals vis-a-vis Indian journals has also been studied in a few articles. The earliest study by Guha et al is now old and the recent studies are not sufficient enough to derive any decisive conclusion. More such studies should be undertaken to find out to what extent Indian contributions are being published abroad, and in which journals so that those journals can be scanned, to notice those articles in Indian abstracting and indexing services.

Use of Literature by Scientists

There are several studies devoted to this aspect. However, the number of such studies are really less and more of such studies will be welcome.

Studies according to Subjects

There is not much to tell in this regard, because the main text of the article has been written subjectwise, wherefrom fallow areas can be easily seen. However, it may be pointed out that studies on social sciences are rather scant. Apart from all these, there are one, two or a few papers on single author study, single article study, single periodical study, nascent subject study, publication activity study of a single institute, time lag study between the submission of a paper and its publication, information content study of a citation and so on. More such studies will be welcome.

LIMITATIONS

1. The study does not cover the unpublished literature.

2. It has failed to cover some articles which have been published in non-library and non-information science journals. It is possible that some studies published in library & information science journals might have escaped our notice.

3. The study has been mainly based on the abstracts given with the articles or found in abstracting journals. Where the abstracts could not be found, matter has been drawn from the title only.

4. It is not claimed that the study is comprehensive but efforts have been made to cover as many articles as possible.

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RELEVANCE OF COLLECTION INVENTORY IN LIBRARY MANAGEMENT: A CASE STUDY OF UNIVERSITY OF MAIDUGURI LIBRARY

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Highlights the experience of a recent stock inventory exercise of the Ramat Libary, University of Maiduguri. The exercise has demonstrated that there is a significant relevance between collection inventory and library management.

INTRODUCTION

In the advanced countries, attention is probably focussed more on the rate of growth and the rate of obsolescence of their library holdings. Both of these areas form part of stock evaluation strategy with a view to weeding less required items. In the developing countries, attention is probably focussed more on the rate of growth and stock inventory. Stock inventory or stocktaking does not form a major part of the worry of librarians in the advanced countries. Certainly, this creates a great deal of concern for librarians in the developing countries.

Two major factors account for the worries of librarians in the region. The first is that the region is undernourished by publishing industries. For example, it is generally accepted that over ninety per cent of world literature are published outside Africa. The rest is published in Africa. If the ten per cent is to be sub-divided among the various countries, some countries will publish .01 per cent. Such and other countries in this region would therefore have to acquire their bulk of literature from overseas. At a time when access to educational materials has become imposed by foreign exchange difficulties, only meagre amount of literature would be acquired both by librarians and book dealers.

Perhaps under the present hard economic condition, students and scholars might have been expected to purchase their own textbooks; but the textbooks are to be imported and are therefore not available because the booksellers face the same hardship as the librarians.

The total effect of all these is that the few textbooks that are in the library become vulnerable to pilferage and mutilation. This is not to say that there is no pilferage and mutilation of library materials in the advanced countries and that is why librarians in the advanced countries are not concerned about stock inventory. They are certainly concerned. The fact is that they are concerned less because they acquire replacements for lost items with relative ease and their inter-library loan services are well-established and reliable.

The proliferation of educational institutions at all levels in the developing countries has compounded the problem. The increase in the physical number of schools up to tertiary level and the increase in number of pupils have not been matched with locally produced or imported reading facilities in Nigeria in particular. It is therefore a perennial problem for librarians to assess their stock in terms of growth and stock inventory to determine the actual holding of the library. It is no longer enough to use the last accession number to answer a question on, 'What is the total bookstock of your library?'

It is not clear how often libraries should undertake complete stock inventory. There have been suggestions that such library inventory should be done quinquennially. Some suggest once in a decade. And yet others say it should be done when opportunity permits. All the suggestions have their merits. It is doubtful if stock inventory should not be more regular in the light of the high rate of disappearance of books from the library and the difficulty now being faced to replace them. If this is done, libraries may be able to determine ways of preventing book disappearance and mutilation. There is no concensus among libraries on this issue. For example, the main library of the Houston Public Library had taken its last complete inventory in 1924 and partial inventories in 1934 and 1943.[1] This Library thus believed in inventory once in a decade. The first was full and the following two had ten years gap or quite close to ten years. But the Library could not continue this ten yearly inventory, probably because it is expensive, disruptive and time-consuming operation. It was in 1968 that they settled for another complete inventory.

Randall, commenting on the exercise of the IRM'S Thomas J. Wastson Research Centre Library which had conducted three inventories of its collection over a period of ten years says, "a library inventory is a demanding exercise which imposes a considerable burden on the staff and something of an imposition on the users. The decision to undertake an inventory should be based on the assumption that the cost and impact on staff morale, are less than the benefits to be obtained."[2]

Montclair Public Library had their first collection inventory in about 40 years in 1977 and the results were surprising[3].

Washington University's Central Library (the John M. Olin Libary) did not undertake inventory until 1970 when it desired to consider alternative security arrangement.[4] At that time, the Library stock had grown to over 850,000 volumes. The Library had to settle for sample inventory.

The Library of the John's Hopkins University in 1969, started a systematic inventory of its holdings of approximately 1,300,000 volumes. The inventory was estimated to last for ten years[5].

In Nigeria, libraries have not been systematic about the frequency of their inventory. In Ahmadu Bello University, Zaria, there was full inventory in 1970/71. In 1974/75, there was a pilot inventory and the library stock had then risen to 105,536 volumes. When the Library moved to its new building in 1975/76, it decided to review the areas of high demand; African history and literature. The writer was a witness of the last two and in fact, he coordinated the second inventory in 1974/75.

The Universities of Maiduguri and Jos undertook their first and full inventory in 1985, i.e., ten years after their existence, when their stocks were under 100,000 volumes.

It is, therefore, clear that there is no agreement among librarians as to how frequently inventory should take place. Each library takes stock as circumstances dictate. But it is obvious from the sample inventories mentioned above that the larger the stock, the more difficult it is to embark on full inventory.[6]

However, stock inventory can be very rewarding when there is a change of leadership in the library. At such time, a complete inventory will assist in identifying the strong and the weak areas in terms of staff, stock, organization, record and above all, it will help to determine the actual holding of the library by identifying losses. In that case, like in any other, stock inventory will assist in the management of both stock and the library in general. However, adequate planning is required to make the stock inventory a success. The objectives of the stock inventory must also be well defined from the beginning. The entire exercise must not be rushed if the desired aim is to be achieved.

RATIONALE FOR THE STOCK INVENTORY IN THE UNIVERSITY OF MAIDUGURI LIBRARY

The University of Maiduguri was established in 1975. It inherited the infrastructure of the North-East College of Arts and Science (NECAS). Therefore, the Library of NECAS had to pass on to the new University; its library resources comprised of 19,000 volumes of books, 580 periodical titles, two senior and eight junior library staff.

The NECAS Librarian was appointed the first University Librarian in 1976. He, however, left in 1977 and a Senior Librarian acted as

University Librarian until November 1978, when another substantive University Librarian was appointed. This Librarian served for four years, November 1978 to September 1982. Then there was a Deputy University Librarian who acted from October 1982 to December 1984, before the present University Librarian was employed in January 1985. A library with this type of chequered history definitely would have problems which a substantive University Librarian would like to investigate on assumption of duty. One of the ways of doing this is by stock inventory.

The NECAS was a pre-degree institution. Therefore, its library collection, as a matter of deliberate policy, was highly duplicated. In some cases, there were as many copies of a title as there were students for the courses taught. This collection had to be upgraded in quantity and quality when the institution was taken over by the University. Later, a policy was evolved in 1978 that a maximum of four copies of recommended texts would be acquired. This policy would be discussed later.

The number of staff improved gradually from two senior and eight junior staff, but the growth was too slow for a very meaningful execution of programmes. By 1978, for example, there were twenty-four members of staff. Six were professional staff out of whom two left at the end of the year. There were three typists from 1976 to 1981.

The shortage of personnel, particularly, professional staff and typists resulted in the inability of the Library to prepare and maintain a comprehensive and up-to-date card catalogue. Books were send to the Library without corresponding cards in the catalogue and in the shelf-list because it was felt that the catalogue slips already written for the books would be typed when staffing situation improved. It was at this stage that Blackwell's Company was approached to sell already prepared set of catalogue cards with books to the Library.

The University of Maiduguri is far removed from good libraries and bookshops. Between 1975 and 1980, the nearest good academic libraries and bookshops were in Zaria, which is 750 kilometres from Maiduguri. Till today, there is heavy dependence on the resources of Ahmadu Bello University Library, Zaria, for inter-library loan by the University of Maiduguri. The University of Ibadan Bookshop sent books to its Maiduguri branch situated at a distance of about 1,509 kilometres. That the Bookshop was run at a loss before it was taken over by the University of Maiduguri in 1981, can be well related to the fact that not enough books were sent to the Bookshop which was the only notable bookshop in Maiduguri. And students could not buy their texts even if they had enough money.

All these were responsible for the University library to consider the policy of purchasing four copies of all recommended texts. This policy was however responsible for the purchase of duplicate and in some cases multiple copies of books. Sometimes, multiple copies of already acquired materials were donated to the Library. Apparently, in later years such multiple copies appeared as if they were deliberate acquisitions, whereas, they were not. The policy was good enough at the time it was made. But it lost its value with time. And the Library resorted to the purchase of single copies in 1983. As from 1982, book business became very difficult.

Few books that arrived in Nigeria could hardly find their ways to Maiduguri. The Department of English, in an attempt to solve its book problems has continued to acquire, when possible, multiple copies of text (sometime up to 50 copies) which were later deposited in the Short-Term Loan Unit of the Library for students' use. This is another reason for multiple copies in the Library. The multiple copies in serials are not because of any policy, but because of improper records.

There are many complaints about missing issues of periodicals and mutilated titles of books. In a raid of students' hostels undertaken on 18th July, 1985, over a thousand volumes of illegally removed, mutilated and long overdue library materials were recovered including books from other libraries around the country.

Thus the stage for stockinventory had been set to enable the new leadership to know exactly where he was to begin.

OBJECTIVES OF THE STOCKINVENTORY

The objectives of the stockinventory exercise were as follows:

a) To reduce the frustration of the library user who is falsely led to believe either that a book is not available in the library becuase such a book is not represented in the public catalogue, or that a book is available in the library when the book has actually been withdrawn.

b) To identify any discrepancies in cataloguing and classification and other technical errors with a view to correcting them.

c) To determine the extent of damage and loss of library materials.

d) To weed out outdated or worn-out materials while identifying those materials for repair and rebinding.

PROCEDURE

A Stock Inventory Committee was formed with Mrs A. Akinnigbagbe, the Law Librarian, as Chairperson. The major part of this paper is based on her report[7]. She worked very hard with her team to evolve specific procedure for books and journals, as outlined below. The procedure for journals became unworkable because it was realised later that it would be better to develop work-sheets basing the journals available on the shelves rather than relying on the records. Duplicates and multiple copies which were discovered were immediately removed.

The management of the manpower was also the responsibility of the Stock Inventory Committee. The shelves were divided among the staff with a fairly experienced staff as a Leader who ensured that his/her group knew exactly what was expected of them. Each shelf bore some class marks which acted as a guide for the group in undertaking the exercise in the Readers' Services, Reference Service, Special Collection and Serials. They were also to count physically, how many books were on their respective shevles.

Although all books were recalled, issue trays were also checked. Books in other parts of the Library, i.e., the Workroom and Bindery, and those known to have been donated to the College Library in Yola, were also counted. There were several transactions of donation to the Primary School. Duplicates and some multiple copies, put away in the store, were discovered after the stock inventory. However, the following procedures were followed in the stock inventory exercise:

a) Procedure for books -

i) "One staff member pulls out a book from the shelf, reads the title, the call number and accession number for the book.

Another staff member holding the shelf list tray locates the correct shelf list card.

The staff member holding the book, marks the book pocket or shelf list accession number (in case of reference books) with year of stock inventory (1985) in red. The staff with the shelf list tray also writes the year of stock inventory (1985) in red beside the accession number located.

ii) When a shelf list card is not to be found for a title, the third staff member in the Group prepares a temporary shelf list card. This card will be used later by the Cataloguing Division to update the shelf list and the public catalogue.

iii) When a title or volume is not located on the shelf, the shelf list card is withdrawn from the shelf list tray. If it is a volume, a question mark (?) is given beside the accession number of the missing volume.

iv) When a title or volume is established to be withdrawn or weeded from the Library collection, the staff member with the tray writes (W), i.e., 'Withdrawn', beside the accession number of the withdrawn volume or against the title, if all the volumes are withdrawn.

v) The withdrawn shelf list cards for African materials must be kept separately from the other withdrawn shelf list cards so that they can be checked further in the Special Collections Unit.

vi) A book that does not belong to the Library must be removed from the shelf.

vii) When the physical matching of books and shelf list is finished, the staff member will arrange the withdrawn shelf list cards, in alphabetical sequence and pull out the matching catalogue cards from the catalogue cabinet if the title is missing. If a volume is missing the shelf list card and the matching catalogue cards will be collected and sent to the Cataloguing Division later to enable them make the necessary changes on the catalogue cards and arrange to file the cards at their own convenience.

viii) The Head of each Group will write a report indicating -

1) The number of temporary shelf list cards written.
2) The number of missing titles.
3) The number of missing volumes.
4) The number of withdrawn titles.
5) The number of withdrawn volumes.
6) The number of books that are not owned by the Library.
7) The number of catalogue cards withdrawn from the public catalogue.
8) Problems encountered.
9) Suggestions, if any"[8].

b) Procedure developed for periodicals -

Although this procedure was not eventually used, it is being included in this paper for the information of readers.

i) "One staff member reads out the call number and title on the representative shelf list card.

ii) Another staff member writes the holdings on the Kardex cards indicating title, call mark, year, volume, issues.

iii) If all the volumes of a journal title are found in the correct location, the third staff member writes on the Kardex card '85 O.K.

iv) When a volume or issue is missing, the space for the volume or issue is left blank on the Kardex card to indicate a gap.

v) All the available volumes must be checked to see if any is mutilated. The mutilated volume or issue must be withdrawn from the shelf.

vi) When a journal title could not be located on the shelf, the represenative shelf list card is withdrawn from the tray.

vii) When a shelf list card cannot be found for a title, the third staff member in the Group should prepare a temporary shelf list card. Information about year, volume and issues available on the shelf must be used by the Periodicals Unit to update their Kardex records.

viii) When a book is found on the periodical shelf, the inventory is taken and sent later to the Group Leader that inventoried books of the same call number.

ix) All unclassified journals must be inventoried to alphabetical order of the title. They will be classified later by the Periodicals Units.

x) Wrongly shelved journals must be pulled out of the shelf to be taken to the correct shelf.

xi) The Head of each Group will write a report indicating -

1) The number of shelf list cards written.
2) The number of shelf list cards withdrawn because the Library does not subscribe to the title.
3) The number of missing titles, volumes/issues.
4) Problems encountered, and suggestions, if any"[9].

SUMMARY OF FINDINGS

a) *Statistical Report for Books*

Total number of books on the shelves.................	55,467
Total number of books in the Workroom................	1,534
Total number of books withdrawn for repair.................	3,371
Total number of duplicates sent to Yola before the exercise	.732
Total number of missing titles......	5,167
Total number of missing volumes ...	8,071
Ovardue books on loan in the Library	1,111

b) *Statistical Report for Periodicals*

Total number of titles	3,576
Total number of unreceived volumes	992
Total number unreceived issues	8,987
Total number of duplicates -	
Bound volumes	1,146
Unbound issues	9,254

ANALYSIS OF FINDINGS

Out of 55,467 volumes of books on the shelves, 11,000 books were not reflected in the catalogue. Another finding was that books on geography, anthropology and economics, philology, Eureopean literature, language and literature of Asia, mathematics, astronomy, physics, chemistry and biology, that is G-GB, P-PN and QA-QH respectively, recorded the highest loss of 2,582 volumes altogether.

If the number of 8,071 missing volumes, are added to the number of books on the shelves (55,467 volumes), and the number of books in other areas of the library i.e. 3,371 volumes in the bindery; 1,534 volumes in the Workroom and 732 volumes sent to Yola Campus, then the total collection adds up to 69,175 volumes. The number of books on loan is 1,111. If all these are returned to the Library, the assumed total holding will be 70,286.

This number falls considerably short of the estimated library holding of about 87,000 volumes as shown by the last accession number at the time of the stock inventory. It then means that faulty records have made it impossible for 16,714 shelf list to be written and missing figure, if any, to be detected in the course of the exercise.

SHORTCOMINGS OF THE EXERCISE

a) It was thought that the shelf list was comprehensive enough for the stock inventory. But it was later discovered that 12,105 temporary shelf list cards had to be written in the course of the stock inventory exercise.

b) There were about 2,000 volumes of backsets of journals which had been catalogued and these were erroneously recorded among the lost books because the practice of cataloguing backsets of journals had ceased some time past and no staff seemed to recall this.

c) The turn-over of staff had not made it possible to keep track of books that might have been donated to other libraries which might have been processed before the donations were made.

d) The target set for the work was very short and made the stock inventory fairly a hurried work. There were about 1,146 bound volumes and 9,254 issues alleged to be duplicates. After the stock inventory, when the Serials Division was cross-checked, it was discovered that 69 volumes and 44 issues were not at all duplicates. This discovery was made after the Library had presented the report of the exercise to the University community.

CONCLUSION

The stock inventory was successful in spite of its shortcomings. It helped the Library to detect the technical errors, and the total number of books physically present on the shelves. It assisted the Cataloguing Division to know the state of the shelf list and the catalogue cards. For the serials, it was useful in straightening the records in the Stripdex and cards. It also helped in seeing to it that all backsets are accessioned and that the backsets are labelled with the appropriate classmarks.

In fact, the exercise is a type of self-auditing in terms of performance. Ever since the stock inventory was done, the sense of direction was again re-awakened in all the staff of the Library.

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INFORMATION IN DEFENCE RESEARCH & DEVELOPMENT

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The paper brings out the characteristics of scientific research in general and defence R & D in particular. The processing of information in defence research is viewed in its overall perspective. It considers, besides the library and information services, supply of information for management decision making, patent and specification framing, technical co-ordination and liaison, technology transfer for civilian use, reporting to government and public.

INTRODUCTION

Maintenance of territorial integrity, safeguarding and promoting national interests are fundamental aspects of statecraft. To achieve this a nation builds and maintains its defence services. With the advancement of science and technology and its impact on the weapons development, the defence research and development (DRD) has become a major concern in all countries. Information resource forms a vital component of the infrastructure needed to support, develop and exploit DRD. Role of communication and dissemination of information in the growth of science and technology is fairly well understood, where as it is not so in DRD.

DEFENCE RESEARCH & DEVELOPMENT

A study of the characteristics of DRD and how it differs from the main stream of scientific and engineering research and technology (SR) will be useful for understanding and handling of information requirements for DRD.

Figure 1 gives the characteristics of the world of SR and that of DRD.

Scientific and technical research can be categorised broadly into pure or basic research, theoretical and applied research including development. The nature and quality of research output, and the working environment generally distinguish the two types. An analysis of scientific research (=SR) seems to indicate that about 10% of the work is philosphic and abstract in nature, 70 to 80% theoretical and applied, and the remaining 10 to 20% directly involved in development of processes and hardware. In contrast, in defence R&D (=DRD) abstract research is almost negligible, while theoretical and applied research and development of hardware account for 10-20% and 80-90% respectively*. What distinguishes DRD from SR is the dominant emphasis placed on hardware development in the former.

Another important feature that characterises the two is the work environment. The envornment surrounding the world of SR is that of academic, research, industry and government, whereas in DRD it is defence forces, government, and industry. Tight security restrictions guarding DRD is a factor that has a bearing on all aspects of handling information. Target time is vital.

Weapons Development Programme

Within the DRD framework, weapons development programmes constitute the core. Information systems have to be geared to meet their requirements. Such programmes generally feature five phases as follows:

a) Exploratory development. Efforts to demonstrate feasibility or to identify possible specific military applications short of major development projects. It may vary from fundamental applied research, fairly fundamental in nature, to minor development activities;

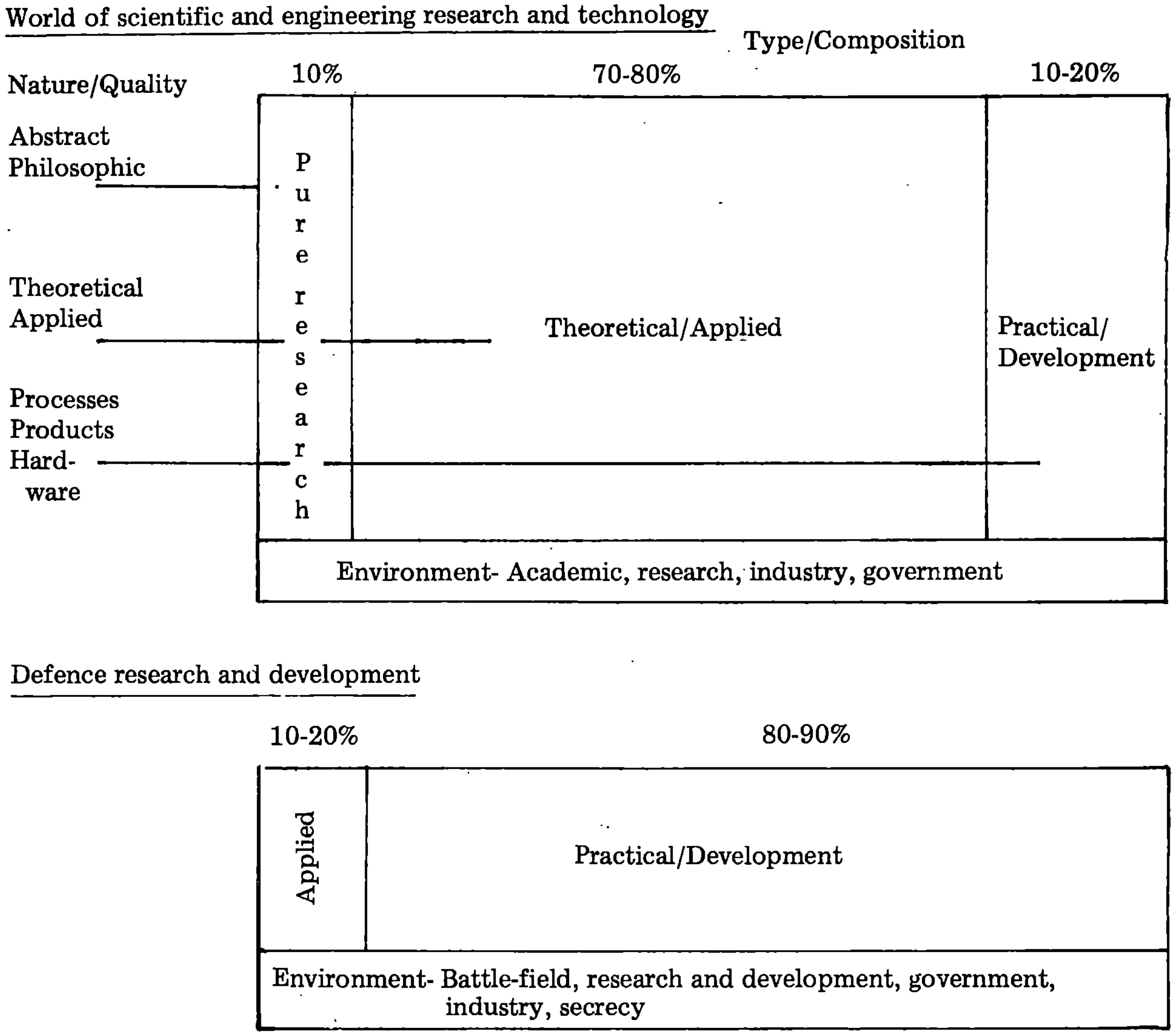

World of scientific and engineering research and technology
Type/Composition
Nature/Quality
10%
70-80%
10-20%
Abstract
Philosophic
Theoretical
Applied
Processes
Products
Hard-
ware
Pure research
Theoretical/Applied
Practical/
Development
Environment- Academic, research, industry, government
Defence research and development
10-20%
80-90%
Applied
Practical/Development
Environment- Battle-field, research and development, government, industry, secrecy

Fig. 1. Feature of scientific research and the defence research

b) Advanced development. Includes all projects that develop components and subsystem hardware for experimental tests;

c) Engineering development. Activities to develop engineering items for service use, but before a decision has been made for procurement or operation;

d) Operational systems development. Development, engineering, and testing of systems, support programmes, and vehicles and weapons that have been approved for production and service employment forming major development projects; and

d) Management and support. Includes support of R&D installations.

Though DRD is directly concerned with the development of weapons, equipment and structures the information gathered during programmes forms a valuable aid to decision making in weapons system selection, acquisition and marketing processes and in turn influences the DRD policies.

DEVELOPMENT PROJECTS

The selection and successful completion of defence projects, according to Zuckerman Committee involve - a) formulation of a draft operational requirement (staff target), b) finalization of operation requirements and technical specifications; c) feasibility study; d) project study; e) "holding" contract where necessary, and f) development contract. In any major development programme, project study is a key component. Important aspects to be covered in project study are:

a) Identification of scientific and technical problems that need to be solved;

b) Bridging the technological gaps that may exist as well as the development of requisite industrial facilities within the time schedule;

c) Calculation of cost of R&D in terms of money, manpower and time;

d) Estimation of products costs, operational life of the weapon, and possible market;

e) Consideration of possible benefits of the technology developed during the project to civil industry; and

f) Final decision on the project after re-evaluating the original operational requirements in the light of the factors mentioned above and the possible technological capabilities, present and immediate future of the enemy that may affect the weapon capability.

Initiation of Projects

The development, production and procurement of weapons and engineering items is a joint task involving Department of Defence, the Service Headquarters, Defence Research & Development (DRD), and Production units. The sponsoring agencies initiate the requirement for a new item or modifications to an existing weapon to the General Staff (GS). The GS coordinates the various requirements, and exercises control over their execution. A proposal formulated by the sponsor is referred to R&D for technical comments and feasibility. In the light of the comments received from the R&D and other concerned agencies, the qualitative requirements are framed. The progress on the project is periodically reviewed.

At the development stage, continuous interaction is maintained between the R&D, sponsor and production units. This is the broad outline of the process; but it may vary from country to country and from service to service.

Scientific & Technical Information Needs

The information requirements of defence research needs scanning vast areas covering science, technology, engineering, medicine, behavioural sciences, management and industry. It follows that meeting information needs of DRD stipulates:

a) Continuous monitoring of research in the fields of science, engineering, and technology, as well as in specific areas of research;

b) Collection of information pertaining to ongoing defence R&D work within the establishment/government;

c) Providing specific information required for the projects and policies thought out by the general staff; and

d) Dissemination of information generated during the project to the benefit of civil industry and general public.

Once a project is approved, the next stage involves development of prototypes, followed by production. The development of prototypes and the production could take place within the government sector or could be contracted to industry. The latter course brings in a new feature to defence information work, in that, the government will be required to supply relevant information of government origin or control to the contractor who may not have access to it otherwise.

By and large DRD is a government activity and hence management of information is subjected to government procedures and bureaucratic control.

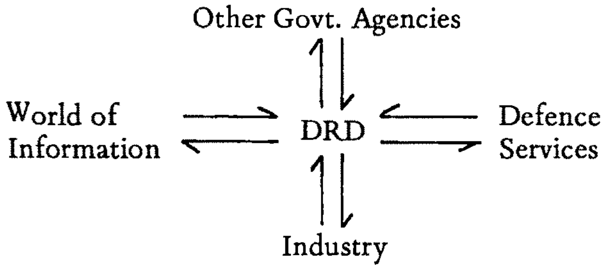
Information system has to (a) meet the requirements of projects and project-oriented activities; and (b) keep up with the latest scientific and technical developments. This distinction gives rise to priority treatment to the first. Though in theory it sounds logical, the two cannot be separated as the latter forms the basic structure and unless it is sound the former activity cannot be fully met. Time and cost factors are critical, since projects are time-bound programmes.

INFORMATION FLOW

There is a close link between DRD activities, the defence services and the industry. At present the information transfer/exchange is mostly between the DRD and the defence services as shown below:

World of Information ⇄ DRD ⇄ Defence Services

Industry and other government agencies are two other components with which the DRD has to maintain effective interaction. Such interaction is of mutual benefit. When such an interaction is established, the pattern of information flow takes the following shape:



Types of Information Activities

Handling of information activities in DRD may be grouped under the following heads:

a) Information centre and library
b) R&D management information
c) Technical coordination and liaison
d) Transfer of technology for civilian use
e) Reporting to government and the public
f) Patenting, standardization.

Information Centre and Library

Scientific and technical information plays a dominant role in achieving the DRD objectives. Hence, the information centre and library has an active part to play. The organization of the Centre is dictated by the nature and needs of the DR and the objectives of the individual laboratory/establishment. Important factors to be considered are: a) the need for emphasis on building up non-book materials i.e. reports, standards, patents, drawings; b) access to unpublished related information available outside the establishment, including firms, c) managing for change in the environment caused by different pattern of projects and users d) project-oriented approach to information; e) time factor; and f) security.

R&D Management Information

Management information is handled by staff officers, technical officers, and heads of various units dealing with equipment, finance, personnel, research programs, assessment and control; besides inter-ministerial and defence service bodies that have a say in shaping DRD policies and programmes. The primary task of these functionaries is that of collecting, selecting, synthesising and reformatting of data and information that goes to make the DRD policies and programmes. The information is transmitted generally in the form of briefs, notes, minutes, summaries, comments, proposals and reports. The data and information are also generated during the process of routine government business, discussions and meetings. In the decision making process, one may use formal sources of information to support, contradict, initiate, find a precedent, compare and solve problems. However, one can trace a published account to be the original source behind many of the DRD management policies and proposals.

Handlers of such information need to be fully acquainted with government procedures, must have an eye and ear for locating and obtaining information from formal as well as informal sources and also the intellectual ability to select, analyse, assess, and draft. They play the role of an aid, advisor, and initiator of policies/proposals. They also control the flow of information at the top, act as sieves and hence play a crucial role with far reaching consequences.

Science decision makers also need to be kept aware of the latest developments in general scientific research outside DRD. Such information provides intellectual stimulus to the top decision makers. Primarily, it is the responsibility of the technical information officer attached to the secretariat to provide such information.

Technical Coordination and Liaison

DRD management is complex in nature. Control is an important function of effective management; and DRD is no exception to this. Control is in relation to the objectives and the charter of duties which in turn decide the various projects and programmes, the facilities to be built up and resource allocation against the progress made towards attainment of objectives. Because of the complexities, coordination plays a vital role in control. A primary function of coordination work is collection of data. The data could be of routine nature or special purpose. There is always a general inertia in gathering and furnishing data at the originating end. Making too many and too frequent demands for data, cumbersome proformas as well as lack of clarity in approach act as hindrances in obtaining data. Data received should be reliable. It is only on such data one can draw scientific conclusions and thereby help control.

In a way, technical coordination is the nerve centre of an R&D establishment. It is here one gets an overall view of the activities of the unit. Because of this, it is possible to coordinate the various activities and programmes, suggest remedial measures when required. Another feature of technical coordination is its referral function, wherein it acts as transmitter of information between a local unit, the DRD corporate headquarters and other related organisations.

Technical coordination in a local unit is also concerned with the collection, control and communication of internally generated information. Often, compilation of periodical, technical and administrative reports, editing and distribution of project reports and data compilations fall within its purview. Hence, persons dealing with technical coordination, apart from having sound technical knowledge, should be conversant with technical writing and effective communication methods.

Other activities coming under coordination are liaison, representation of the unit outside, and development of communication channels within the unit. In all these activities knowledge of the information specialists, trade and tools would be very useful.

Transfer of Defence Technology for Civilian Use

Some of the results of R&D work can also be utilized for civil use, apart from industry. Thus, the money spent on DRD can also contribute to national development. Exploitation of DRD research for civilian use calls for establishing a systematic and continuous process of:

a) Evaluation and dissemination of DRD results that have potential applications in civil field;

b) Identification of users and organizations who could benefit from DRD information; and

c) Restructuring of DRD information in a form that is easily disseminated, quickly assimilated and utilised.

It is in this area, where the various information centres of DRD and the persons involved in technical coordination and liaison can contribute most. The task is difficult and calls for a policy decision to this effect at the highest level and the use of techniques of salesmanship and liaison in technology transfer. Communication can take the form of information sheets or bulletins, consultancy work by DRD experts, free access to DRD patents and their exploitation; and permitting the use of DRD held equipment and facilities subject to security safeguards.

Reporting to the Government, Parliament and Public

In a parliamentary democracy, the government is answerable to the parliament. Since DRD is a government activity, DRD authorities are accountable to the Ministry of Defence. Apart from submitting periodical reports to the Ministry, DRD is often called upon to furnish information to the parliamentary bodies such as Public Accounts Committee, Consultative Committee and also to the Planning Commission. Collection, compilation and submission of information on the working and achievements of DRD forms a part of DRD information handling. Persons handling such information have the onerous task of ensuring that the reporting is precise, factual and unbiased.

Apart from the government and the parliament, the public needs to be kept informed of the achievements of DRD. Enlightened discussion and public interest in DRD work are the surest way of obtaining support for DRD and also dispel wrong, false or twisted opinion that may be created due to closed approach.

Patenting, Standardisation

DRD generated information includes data for patents, standards and specifications. Dealing with this type of information is a specialised job. Those entrusted with patenting should have the knowledge of patent procedures (filing, sealing, inspection and selling) and also the patent law. Framing and issuing defence standards and specifications are also a part of the DRD work. Persons concerned with this work should have an in depth knowledge of the defence requirements, tolerance limits and environmental conditions, sound technical background, and method of framing standards or modifying an existing specification due to changing requirements.

CONCLUSION

Information handling for defence research and development is a multifaceted activity. Besides library and information services, the spectrum of DRD information handling includes a variety of functions such as information part of DRD research, management decision making, patenting and specification framing, technical coordination and liaison, technology transfer for civilian use, reporting to government and public. An understanding of the nature of DRD and development projects in relation to information is essential for efficient and effective handling of DRD information. Persons concerned with DRD information handling should also note that the most effective and creative information handler is the scientist or service engineer who is not only the user of information but many times the originator; although he handles information for himself.

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DEVELOPMENT OF EXPLORATION GEOPHYSICS AND ITS INFORMATION ACTIVITIES

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Traces the development of exploration geophysics as a scientific discipline and discusses the factors responsible for its development. Recent trends in geophysical research are discussed briefly. Details of professional societies and their role in controlling the information activites are given. Publication trends of two leading journals in exploration geophysics are presented in tabular and graphical forms.

INTRODUCTION

Earth sciences have a large data base and rich literature. Since geological information retains its value for a considerable period of time, the data and information are stored in a variety of forms as permanent record for future consultation, correlation and utilization for further studies. Like other sciences, earth sciences have been accumulating a vast amount of data and the process is exponential since last three decades.

Geophysics has contributed a major proportion of data to earth sciences. Exploration geophysics is still a very young scientific discipline, but has been developing very fast since last two decades. The growth of data and information has accelerated of late because of new ventures in offshore prospecting and availability of technology.

DEVELOPMENT OF EXPLORATION GEOPHYSICS AS A SCIENTIFIC DISCIPLINE

Before the information activities are discussed, it would be helpful to discuss the various aspects of development in exploration geophysics as the development of exploration geophysics as a scientific discipline is directly related with the development of information activities in this field. The points like formation of professional societies and associations, their activities for the promotion and progress of the discipline, publication of journals, state-of-art reports of geophysical data and other forms of literature and information would be considered later. Here, I would like to discuss the aspects of development of the subject as an independent discipline and factors responsible foı the growth of data and information in exploration geophysics.

HISTORICAL DEVELOPMENT

Methods of geophysical prospecting in a way as we see them today started about 1923 for mineral exploration and since then they have become increasingly important because of oil exploration. Mediunin[6] has given a good historical account of the development of geophysics and has argued that exploration has emerged as an independent scientific discipline. De Golyer[3] has reviewed the development of gravity and seismic methods in early thirties of this century. Heiland[5] and Rust[7] described some of the early attempts to employ electrical methods. Eckhardt[4] a pioneer in the field has given an excellent historical account of instruments and techniques used in gravitational methods. Schriever[8] recounts the experimental work attempting to develop the reflection seismic methods in early 1920s. Weatherby[9] has given a general historical account of seismic methods. The early developments in the methods of exploration geophysics have been described by these authorities. Later developments have been reviewed by the experts in the various issue of professional journals of exploration geophysics. The most interesting review articles appeared in *Geophysics* in the years 1955 to 1958. Although these articles are addressed to the scientists but they are equally important and interesting for the librarians and documentalists to prepare state-of-art reports on various topics in exploration geophysics. The fourth in the above mentioned series is one by White[10] who has reviewed technological developments in exploration geophysics. Another paper of Born[1] highlights the developments of geophysical instrumentation. The progress of the development of geophysical methods – instrumentation, data processing and interpretation, achievements in exploring more oil fields etc. are reviewed in one of the issues of *Geophysics* every year.

The most interesting thing to note from all these reviews is that the development of geophysical prospecting methods was steady upto 1940 and thereafter it started accelerating at a faster rate and this rate has been very fast during the last twenty years. Another point of interest to note is that every geophysical method has had its period of initial trial, followed by its peak commercial application over a period of few years. As areas amenable to a particular method have been studied and covered, the popularity or application of the method decreased and it was replaced by other methods. The succession of one method after another sometimes followed rapidly. At other times there has been considerable lapse of time between peak applications of various methods. Each method has had a limited period of maximum commercial utility and activity because it either eventually covered the most amenable areas, or else was succeeded by a narrower technique (modified/refined) having economic advantages. A nice and detailed description regarding the discoveries of new fields and relationship with development of new ideas and method is given in the *Bulletin of American Association of Petroleum Geologists* in 1958 in its fourth issue.

FACTORS RESPONSIBLE FOR THE DEVELOPMENT OF EXPLORATION GEOPHYSICS

Important characteristics of modern sciences in their development is their utilitarianism. Today, earth sciences are of tremendous importance providing the minerals as raw materials for industry. The data of earth sciences help to ensure the most profitable and expedient interaction of human society and nature. Over the ages, this interaction has been growing ever more deep and diversified. Through this diversity two important tendencies can be traced: firstly, the utilization of natural resources, and secondly, reasonable consideration and utilization of the properties of the natural environment affecting man's activity.

Utilization of natural resources

- Utilization of the total resources of useful minerals in industry is rapidly increasing;
- Energy consumption by human society is increasing in leaps and bounds;
- Accelerating productive forces for economic development;
- Transforming the nature in the interest of man.

Importance of the properties of the natural environment

Man's environment - the terrain, mineral resources, climate etc. greatly influence his activity and sometimes determines various aspects of it.

Geophysics among earth sciences and applied geophysics have contributed their share for these causes in general and several other factors in particular. A few factors for the progress of exploration geophysics and related information activities are discussed as below:

1. Chiefly due to stiff commercial competition, exploration geophysics is a dynamic art continually changing and increasing;
2. The main incentive to modern exploration geophysics was the search and its success for oil during the early years of this century. An increased demand of oil and the inadequacy of the haphazard methods of the early "wild catter" in meeting the demand forced the development of the new science of petroleum geology and with it the effective tools of geophysical exploration;
3. Geophysical methods have been successful in the search for oil primarily because of their ability to determine the geologic structures and mapping conditions favourable for oil accumulation;

4. In its struggle to keep up with ever increasing demand for its products, the oil industry is expending great effort and enormous sums of money to find new oil and gas resources - directly or indirectly invested in the development of exploration geophysics;

5. Developments in physics, electronics, and other scientific disciplines have directly influenced the development of exploration geophysics;

6. Development in modern technology, to mention a few, computer technology, satellite communication, aviation and shipping transport means;

7. Geophysical instrumentation depended upon the development of electronics and mechanical engineering, designing, developing and construction of instruments was largely influenced by the development of these fields;

8. Techniques of recording were improved with the improved quality and means of recording. Computer technology has been mainly responsible for this progress. Airborne and shipborne recording has improved enormously with the development of technology. Better menas of communication have mostly influenced this development;

9. Techniques of data processing and interpretation have tremendously improved with the increasing application of computers and computer graphics;

10. Modelling and simulation techniques have developed to the same extent for the similar reasons and ability of equipments and better facilities available in the laboratories;

11. Offshore ventures and the recent success of geophysical methods to discover more reserves, and ability of modern technology to tackle hazardous problems of offshore production has boosted the progress of exploration geophysics. Now more funds, more people (scientists and technologists) are available for the development of this science.

In short, it could be said that the science and art of exploration has in general kept pace with the advance of civilization and the improvement in methods for refining and conserving mineral resources. The development of exploration geophysics is global and it is expected that the present trend would continue even at a faster rate in the coming years.

RECENT RESEARCH TRENDS IN EXPLORATION GEOPHYSICS

The combination of the future development, differentiation of sciences and the development of geophysics led to an independent scientific discipline, namely *Exploration Geophysics* which is characterised as a particular research subject and a set of particular techniques. Now the future development in the methods of exploration geophysics, improvement and development of new instruments, new techniques of measurement, processing and interpretation are not conceivable without further expansion and use of theory of exploration geophysics and corresponding physical and geological principles. Therefore, there is a shift in thinking from the previous concepts of accumulating data and facts only to the new trend of explaining them. Some new trends of research in exploration geophysics are discussed below:

Field Recording

The normal field recording for commercial purposes continues with more refined techniques and more sophisticated materials and instrumented. New techniques like remote sensing and holography are being experimented. Emphasis is more toward offshore surveys;

Study of physical and physico-chemical parameters of rocks and real media on which the various geophysical methods are based

Complex investigations of physical properties of rocks under both natural and laboratory conditions (under varied temperatures and pressures) are being performed in order to understand relationships between geological and geophysical characteristics. Theoretical principles of direct and indirect methods for prospecting are being formulated.

The study of characteristics and properties of the various geophysical fields: (modelling studies)

New means for exciting geophysical fields based on model studies are being examined. Models of various features of the earth are constructed and tested to ascertain their response to given variation in physical parameters. Studies are aimed to predict geophysical fields in complex models of real media.

The study of the relation between geophysical fields and the medium, construction of improved models of media and development of interpretation methods

Based on the investigations above, new methods of interpretation are being developed.

Computer Softwares are being developed to solve complex problems of data processing and interpretation and also displaying the various kinds of maps and sections.

Development of instruments

There is a new trend of thinking, designing and developing more sophisticated electronic equipments - mostly computer based - more compact and portable and capable of recording more and more information of complex nature.

One could very distinguishingly note that the recent research and development trends in exploration geophysics are of the same nature as should have been for any scientific discipline of applied nature. To summarise the above research and developments, two features could be noted with interest:

1. Trend for conducting fundamental or academic research which includes laboratory experimentation, model and simulation studies;

2. Trend for Research and Development type of studies which include designing and developing instruments, improvements in the materials used, development of computer softwares for automatic data acquisition, processing and interpretation and graphical display of results of interpretation.

INFORMATION ACTIVITIES IN EARTH SCIENCES AND EXPLORATION GEOPHYSICS

The normal process of generating geoscientific information is collection of data from the field by collecting samples or by observations or recordings; processing the data in the laboratories and computer centres; interpreting the processed data in geological terms; and then finally submitting the report of investigations with final results and recommendations.

Most of geophysical data are accumulated by recording natural or artificially created geophysical phenomenon by very sophisticated electromechanical instruments. The normal output of data is a reading or observation noted in the field note books, or paper record or now mostly in a tape record. The field data thus obtained in large quantity are preserved in the headquarters of most organizations and institutes and retrieved whenever required for reprocessing and reinterpretation manually or in most cases now by computers. Processed data in the forms of graphs, charts, sections or maps etc. are separately collected and preserved for interpretation purposes and retrieved later for reinterpretation purposes. Final reports of investigations are then deposited in the central repository. Most of the data of this kind is of commercial and classified nature and kept confidential within the organization for long time, released later after a certain period for academic and public use. This kind of literature, i.e. *Report Literature* is difficult to access and acquire for general consumption. Since this data is important and of commercial value and use, it is very systematically gathered, processed, organised, stored, maintained and retrieved but rarely disseminated. Another kind of data is the normal primary literature published through scientific journals or patented with the patenting authorities. Broadly, geophysical information could be classified into two categories:

1. Commercial Information (field data, processed data and reports of investigations);

2. Scientific Information (primary research findings).

Scientific information has all the same characteristics and forms and its bibliographic control as we observe in other disciplines of science and technology. Characteristics of geoscientific literature are described by Craig[2]. Geophysical information can be described as: Geophysical Information = Data + Literature in all its forms.

Following discussion would be useful and helpful to understand and appreciate the role played by professional societies in promoting the organization of geoscientific literature in general and geophysical literature in particular.

PROFESSIONAL ASSOCIATIONS AND SOCIETIES

Professional associations and societies play a very important role, promoting the scientific interest of their members; promoting the development of areas and disciplines to which they are concerned with; disseminating knowledge of science among members; maintaining professional standards; developing educational and training programmes for the students and for developing competent manpower; establishing contacts between the members and conducting many such activities.

There are more than 100 such associations and societies in earth sciences all over the world. Gale's *Encyclopedia of Associations* mentions about 28 associations in United States alone. These organizations can be categorized in their scope as national, regional and international. Some of them cover broad field of earth sciences, some of them geophysics and a few of them represent highly specialised fields like exploration geophysics. The details of few organizations which are directly or indirectly and partially concerned with exploration are given in the following section:

Society of Exploration Geophysists (SEG)

Address : Box 3098, Tulsa, Oklahoma, 7401
(USA)
Founded in 1930; Members : 9442 (1975);
Staff : 15; Local groups : 24

Donald C Barton organized society of Economic Geophysicists in 1930, with 46 geologists and geophysicists. The Society of Petroleum Geophysicists was founded in late 1930, held its first convention in March 1931 with Association of American Petroleum geologists. Only 57 papers were published during 1930-1935, and there were only 189 members in 1935. The society started its own journal – *Geophysics* in January, 1936. Today, SEG's membership is more than 10,000 representing more than one hundred countries. It is primarily an international organization of exploration geophysicists. Table 1 gives the data on membership of the society which is self explanatory to give an idea of its growth.

Table 1

Membership of SEG, 1930-1980

1930	46 members
1935	189 "
1955	4,764 "
1975	9,442 "
1980	13,550 "

Table 2

Publications in Geophysics, 1930-1980

Year / period	No. of publications
1930-1935	57
1936-1945	294
1946-1955	429
1956-1965	646
1966-1975	733
1976-1980	521

Table 3

Publications in Geophysical Prospecting, 1953-1980

Period	No. of publications
1953-1955	14
1956-1965	290
1966-1975	417
1976-1980	239

Note : Year to year distribution of publications of *'Geophysics' and 'Geophysical Prospecting'* is shown in Figure 1.

Following figures give an idea about the diversity of membership:

40% members represent petroleum companies;
20% members represent private geophysical contractors/consultants
20% members represent mining and engineering companies;
20% members represent academics.

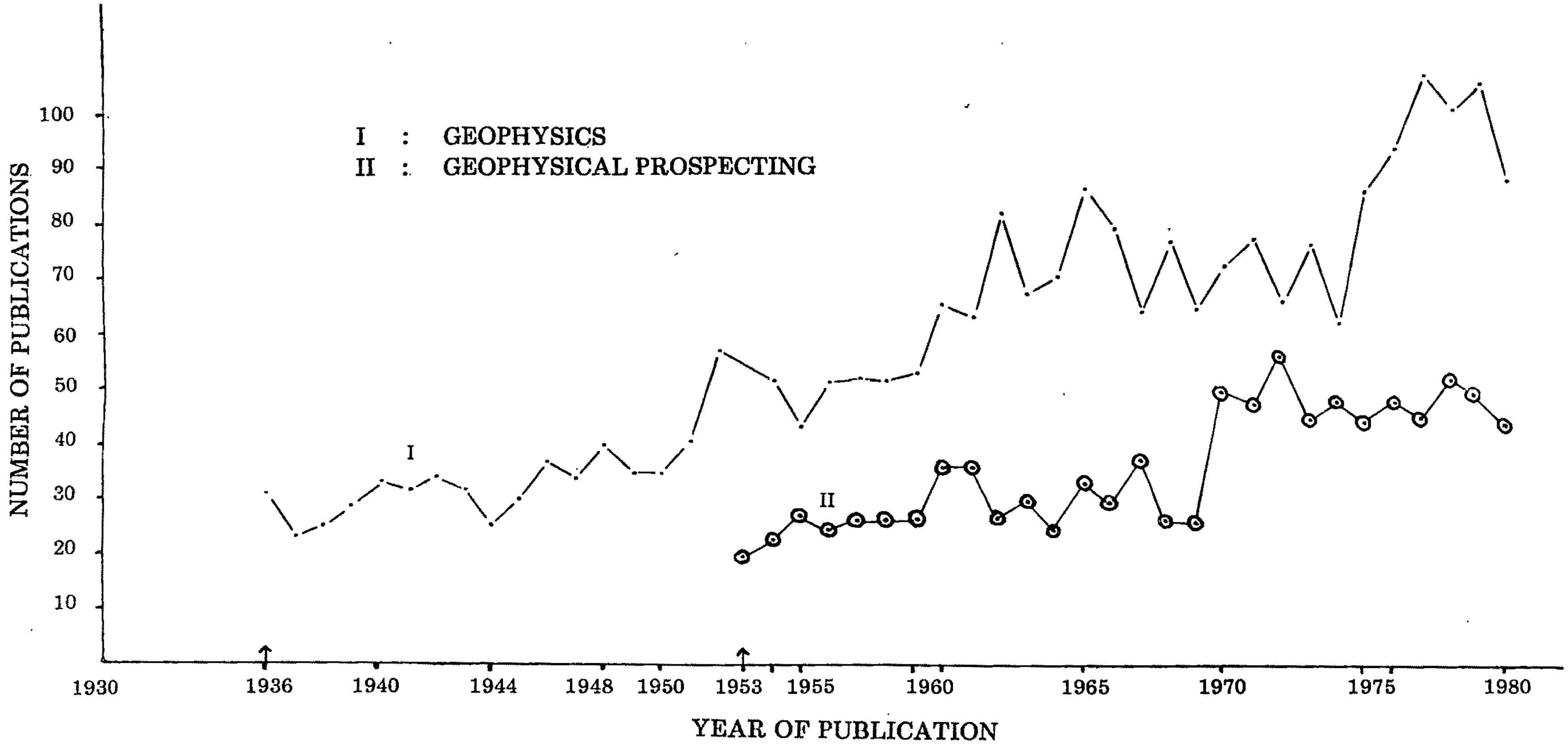

Fig. 1: *Frequency Distribution of Publications in Exploration Geophysics: 1930-1980*

Society consists of 14 different committees to look after the various affairs of the society.

Publications

- o Geophysics (scientific and professional journal - now monthly);
- o Yearbook;
- o Monographs, glossaries, indexes and items of academic and professional interests;
- o Proceedings of conventions and annual meetings conference.

European Association of Exploration Geophysicists

Address : 30, Carl Van Bylandt laan,
The Hague (Netherlands).
Founded : December, 1951; members: 2,500 (1975)

The association was founded with 300 active members which doubled in a year. Now, there are more than 3,000 members from sixty countries. The percentage distribution in 1964 was as below:

France	:	35%
Germany	:	21%
U.K.	:	19%
Holland	:	14%
Italy	:	6%
Others	:	5%

Publications

- o Geophysical Prospecting (1953- quarterly journal);
- o Occasional papers;
- * See Table 3 for distribution of publication (1953-1980)

American Geophysical Union

Adress : 1909, K St., N.W.
Washington D.C. 20006 (USA)
Founded in 1919; members : 12,000
Sections : Geodesy, geomagnetism, Paleomagnetism; Hydrology; Meteorology; Oceanography; Planetology; Seismology; Tectonophysics; Volcanology; Geochemistry and petrology; and Exploration Geophysics;

Publications

- o Journal of Geophysical Research (3/ month);
- o EOS Transactions (monthly);
- o Water Resources Research (biomonthly);
- o Reviews of Geophysics and Space Physics (quarterly);
- o Radio Science (monthly)

Some Russian journals are translating them cover to cover:

- o Izvestiya: Atmospheric and Oceanic Physics, (monthly);
- o Izvestiya: Physics of the Solid Earth, (monthly);
- o Geodesy and Aerophytography (bimonthly)
- o Geotectonics (bimonthly)
- o Oceanology (bimonthly)
- o Soviet Hydrology and Selected Papers (bimonthly)
- o Soviet Antarctic Expedition Information Bulletin (irregular).

American Geological Institute

Address : 5205, Leesburg Pike, Falls Church, VA 22041 (USA)
Founded in 1948; members : 18

American Geological Institute is a federation of 18 national scientific and technical societies in the field of geology, geochemistry and solid earth physics.

Aims

- o career guidance programmes;
- o to improve teaching of geological sciences in public schools; colleges and universities;
- o seeks to maintain high standards of professional training;
- o sponsors documentation and translation services for geological sciences.

Publications : several of international standards;

- o operates GEO-REF, a computer based reference file of world-wide geological literature.

International Union of Geological Sciences (IUGS)

Address : P.O. Box 379, HAARLEM (Netherlands)

Founded : 1961; Members : Representatives of national committees for geological science;

Aims : International cooperation in geology and related science;

Publications : Geological newsletter (quarterly);

Geoscience Information Society

Address : C/o American Geological Institute, 5205, Leesburg Pike, Falls Church, VA 22041 (USA)

Founded : 1965; Members : 250; librarians, documentalists, information specialists, editors, geologists, and other earth scientists;

Aims

- o to promote the exchange of information in the earth sciences;
- o seeks to recruit technically trained people in the profession;

Committees

- o Earth science union list committee;
- o Field reference guide books committee;
- o Subject headings committee;
- o Theses Committee;

Publications

- o Newsletter (4/year)
- o Proceedings (annual)
- o Directory, bibliographies, union lists and scholarly publications.

Geological Information Group (GIG)

The group was founded in 1971 by Geological Society of London to study geological information in all its aspects including the principles of recording, indexing, collation, storage, retrieval, dissemination, editing and communication.

Association of Earth Science Editors

Address : C/o American Geological Institute, 5205, Leesburg Pike, Falls Churg, VA 22041

Founded 1967; Members : 100; editors, managing editors and others in editorial management positions of publications in the field of earth sciences;

Aims :

- o to promote effective publications of journals, reviews, monographs, abstracting periodicals and services, indexes, microcards and other publications which disseminate knowledge on earth sciences.
- o to be affiliated with AGI and EDITERRA (European Association of Earth Science Editors);

Publications : Blueline (quarterly)

CONCLUSIONS

The development of exploration geophysics has accelerated in the recent years. The main reason of this fast development is commercial application of geophysical methods in search of mineral resources. Information activities are mostly controlled by the professional societies. Two of the societies (SEG and EAEG) are mostly concerned with the science of exploration geophysics. Both of them are international in their scope of membership and activities. The next three organisation discussed are indirectly or partially related to exploration geophysics. Association and organizations mentioned next are directly concerned with the geoscience information activities - publishing, documentation, and dissemination and editorial activities. A further study of trends of growth in size, volume, number of authors and kinds of materials etc. would be more useful. Citation analysis study of the literature could be useful to determine the usage pattern of the information sources.

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NATIONAL LIBRARY OF MEDICINE : ITS INTERNATIONAL PROGRAMMES AND SERVICES

GAYAS UD DIN
Sheri-Kashmir Institute of Medical Sciences
Srinagar 190001

Outlines the information programmes of the National Library of Medicine, primarily oriented towards international biomedical communication network, and traditional exchange of literature which has been extended to collaborative arrangements with technically advanced countries for NLM's computerised information systems. Discusses the technical consultations and resources provided by NLM for the establishment of national and regional biomedical information centres.

The international programmes and services of the National Library of Medicine (NLM) are based on a cooperative sharing of services, and can be characterised in six general categories—

Literature Exchange Programmes
Library Services
Special Foreign Currency Programme
MEDLARS Cooperative Arrangements
Technical Consultations and
Cooperation with International Organisation.

They are a blend of activities with a variety of mechanisms for execution but all have the common objective of direct benefit to the medical community.

LITERATURE EXCHANGE PROGRAMMES

The library has 400 exchange partners in 72 countries throughout the world from whom considerable material is acquired and exchanged. These exchange partners now include USSR, Cuba and the Peoples Republic of China. The basis of this strong exchange programme was conceptually laid down with the historic commissioning of Dr. John Shaw Billings in 1881 to visit a number of libraries on the European continent.

LIBRARY SERVICES

The Library has responded to international requests for traditional information services. From 1966 to 1978, NLM had a special arrangement with the United States Agency for International Development (USAID) to provide annually approximately 30,000 services to 48 developing countries throughout the world. These include inter-library loans, reference services, MEDLINE searches, subscription to *Index Medicus, Abridged Index Medicus* and *NLM Current Catalog*. These services proved to be of great value in those countries where modern medical information is unavailable because of inadequate facilities, collections and staff.

The broad geographical distribution of these NLM/AID services was approximately 64% in respect to Asia, 33% to Latin America and 3% to Africa in 1978. The subject matter extended over all aspects of health - delivery of primary health care, education and research - and covered broad topics such as nutrition, environment, communicable diseases as well as speciality areas.

SPECIAL FOREIGN CURRENCY PROGRAMME (PL480)

NLM's Special Foreign Currency Programme is authorised by PL 83-480 whereby funds accrued to United States by the sale of surplus agricultural commodities are spent in the country of origin on projects mutually beneficial to both countries. NLM initiated programme in India, Pakistan, Poland, Yugoslavia, Israel, Egypt and Tunisia. To start with, these programmes produced translations of the specialised biomedical literature from Russian, Polish etc. into English so that the information therein would be available to the scientists in U.S.

In 1964 the NLM began to change the character and emphasis of this programme from the translation activity to the development of bibliographic tools useful for medical community engaged in research, education and practice.

Many health-related directories, hand books, monographs, histories of medicine and critical reviews have resulted from special Foreign Currency Programme.

MEDLARS COOPERATIVE ARRANGEMENTS

The *MEDLARS data base* and *Index Medicus* are international in character. The 2,598 serials covered by *Index Medicus* represent 30 languages and 73 countries. Out of these, 59% serials are in English only and are produced in 49 countries. English is also the primary language in 63% of the 365 multilingual journals. Forty eight countries other than United States publish medical literature primarily in English indicating that there has been a shift towards English as a language of biomedical publications.

Because of the nature of the data base, many countries were interested in obtaining MEDLARS computer tapes as soon as the system became operational in 1964. The NLM began international cooperation with U.K. and Sweden for their experimental testing of NLM's new computerised system. With the successful operation of the scheme with U.K. and Sweden, it became clear to NLM and was agreeable to other countries, that definite bilateral agreements would be desirable. NLM now has bilateral agreements with Pan American Health Organisation and ten other cooperating countries, namely, Germany, Japan, Sweden, U.K., Australia, France, Canada, Italy, Mexico and South Africa. The arrangement was discontinued with Iran in Jan. 1979.

NLM makes available the MEDLARS system either through tapes or online access to NLM computer. The participating country must meet the technical criteria involving personnel, equipment and monetary resources and have a user community large enough to justify an extensive computerised service activity. The participating country then provides and funds the indexing of journal articles for inputting to MEDLARS data base and in return gets access to the system.

These international agreements are evaluated periodically by International MEDLARS Policy Advisory Group (IMPAG) which consists of representatives from NLM and the countries with a MEDLARS Centre to ensure continuing technical and professional benefit. NLM has called five IMPAG meetings since 1972 to examine the nature of cooperation, operational experience, new data bases, regional coverage and future cooperation.

TECHNICAL CONSULTATIONS

Nations are becoming increasingly aware of the value of scientific and technical information. NLM often assists in the designing of national biomedical information centres or imparts specialised training and work experience to individuals. The Library is often called upon for other technical consultations by organisations concerned with developing a regional approach to solving information problems. Problems of many countries would require action relating primarily to medical setting, such as strengthening of basic collection of libraries, the training of library staff and the relationship between medical librarian and physician to increase the awareness on the part of the medical community of the value of a modern medical library.

COOPERATION WITH INTERNATIONAL ORGANISATIONS

NLM has varying degree of involvement with a number of international organisations, both government and non-government, scientific and non-scientific. These include the United Nations; the UN's specialised agencies which have a health or scientific orientation such as World Health Organisation (WHO), Pan American Health Organisation (PAHO) and United Nations Educational, Scientific and Cultural Organisation (UNESCO), economic organisations such as Organisation for Economic Cooperation and Development (OECD); and scientific agencies such as International Council of Scientific Unions-Abstracting Board (ICSU-AB).

NLM's involvement is often derived from its experience in biomedical communications and the international organisation's efforts to relate this experience to larger questions of special significance.

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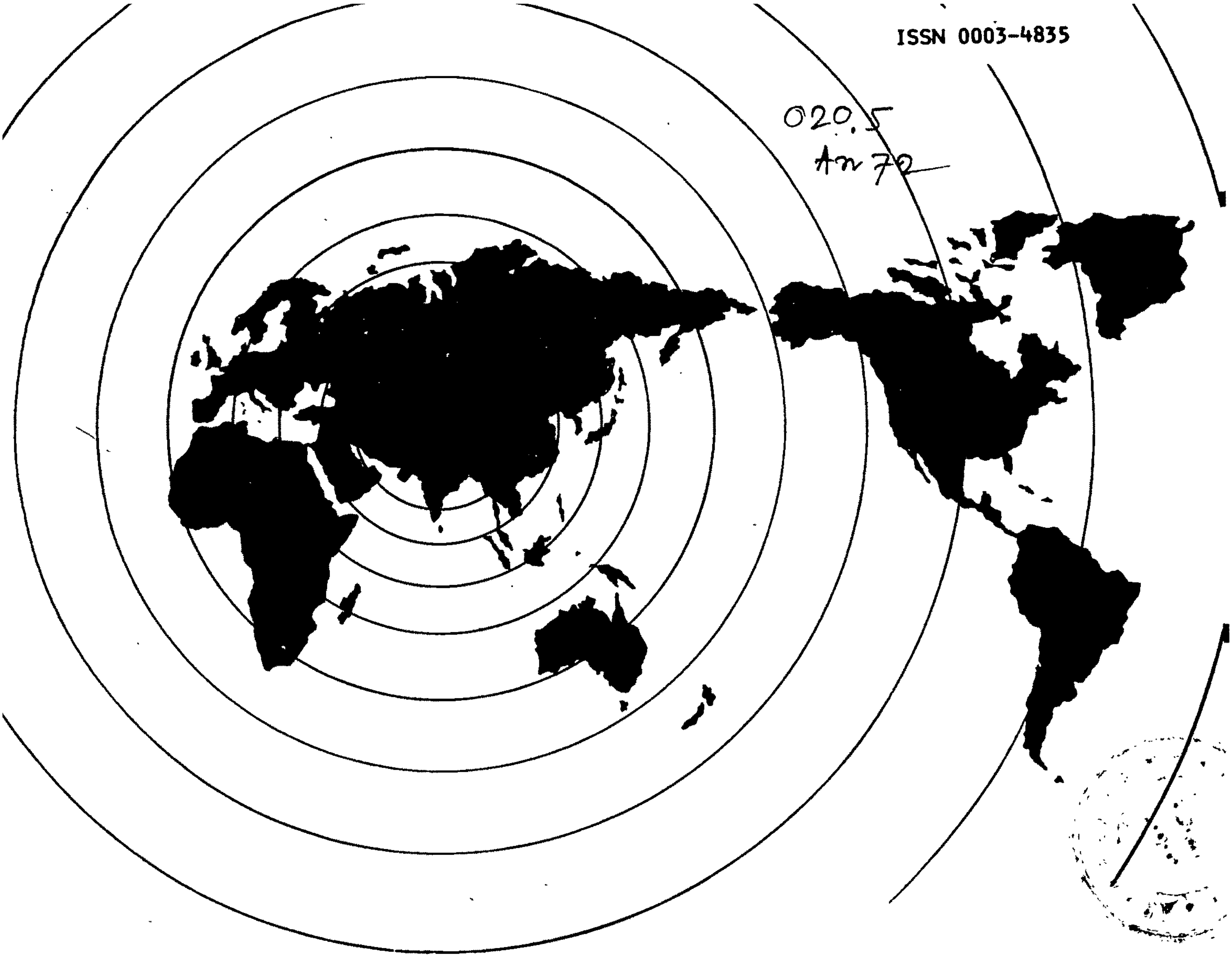

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43rd FID CONFERENCE AND CONGRESS, 1986 – A SUMMARY

INFORMATION, COMMUNICATION AND TECHNOLOGY TRANSFER

The 43rd Conference and Congress took place in Montreal, Canada, between the 8th and 19th September and was attended by more than 300 information and documentation specialists from 48 countries.

During the first week, supported by UNESCO, FID/ET held a seminar on Education and Training for Technology Transfer. This was essentially an exchange of experience between those concerned with educating information specialists, who may find technology transfer one of the situations they will encounter at work, and a review of the situation in developing countries. Part of the seminar was jointly organized by the Information for Industry committee, FID/II.

Other seminars during the first week were held by FID/CR - Classification and Indexing Research - and FID/SD - Social Sciences Information and Documentation.

OPENING SESSION

At the opening session of the main Congress, there were welcoming speeches from representatives of the Government of Canada, the Government of Quebec and the City of Montreal. In formally opening the Congress, the President of FID referred to the new programme of activities and strategic plan adopted by the General Assembly only two days before, and illustrated how the theme of the Congress fitted very closely with the thrust of the new programme. He also cited new FID initiatives already underway which also coincided with the Congress theme.

The Keynote Address of the Congress was given by Dr. Larkin Kerwin, President of the National Research Council of Canada. He started his presentation by stressing the truly international nature of science and that the community of scientists transcends national borders. He went on to examine the concerns currently being expressed by many organizations involved in the dissemination of information about the increasingly restrictive copyright constraints. New and projected legislation seems to be likely to restrict still further the proper flow of information between scientists and between science and technology.

The speaker recognised that the regulations had the laudable intent of giving authors more protection but their perhaps unintended effect would be to restrict the free flow of data across borders.

In the information field, Dr. Kerwin identified a paradox: information is growing exponentially and the new communication technologies are making it easier to transfer large quantities quickly. However, restrictions on the free flow are also growing due to economic, political and industrial pressures. He reminded the audience that, despite the risks, laboratories must exchange data if they are to achieve fruitful results. He concluded that the rewards of using information outweigh the risks.

Information - theories, tools, systems (M.Dupuis)

The first working session of the Congress covered a wide range of topics. Professor Curras related the evolution of intelligence and communication to biological evolutionary processes using System Theory to support her arguments. In this way she was able to speculate on the role of technology in the evolutionary process. The next two papers discussed establishing the necessary infrastructures for the effective development of information work in developing countries. Dr. Rozsa described a possible integrated model. Mr. Courrier spoke about the important role UNESCO is playing in ensuring that the new information technologies can be used.

Dr. Brisfjord described some interesting attempts to establish computer literacy in sparsely populated areas in Scandinavia and the subsequent use of the computers for educational purposes. A questioner drew attention to similar work in the remoter areas of the USA.

Turning from new technology and information for education to the needs of the information profession itself, Dr. Ourston described an artificial intelligence system (ARM) designed to assist document editing, document writing and the use of smart interfaces, and Professor Fujiwara described the use of multi-lingual three-way thesaurus to assist information transfer. The thesaurus is stored on a CD-ROM and manipulated on personal computers.

Professor Jackson described what the head of an information unit must do to convince management of the cost-effectiveness of the unit and hence ensure its survival. He emphasised that arguments and data must fit management's style of assessing the value of other company activities. Professor Canisius took concern with survival one step further and asked whether expert systems would eventually replace documentalists. The consensus view was - no!.

Access to Information Via Telecommunications (Professor Canisius)

This session dealt with some of the most modern possibilities in the information world and, at the same time, clarified the present limitations to their application.

Dr. Strauch gave an overview of the possibilities of interactive videotex in Europe with a special view to application in a more professional information environment. Mr. Pollitt then outlined in more detail how viewdata searching capabilities were achieved and described the Boolean searching facilities.

Professor Martin then talked about another facility of today, already available for some years but not yet enjoying adequate widespread use: electronic mail.

Dr. Harmsen described successful applications of a modular marketing tool in the telecommunication area in various sectors of industry.

Dr. Fjallbrant outlined the potential for the future of satellite document delivery and described current development work being undertaken.

Dr. Black's paper ((presented by Ms.Pearson) described computer conferencing and ably discussed details of applications of this promising means of modern communication with the floor.

Finally, Professor White revealed how much is printed and shelved today without ever being read.

Thus the session pointed to future possibilities and misuses of wrongly timed or inadequately applied techniques at the same time. Over and over again the discussion became one about achieving effectiveness rather than merely improvements in efficiency. Obviously effectiveness is more valuable than efficiency, especially if one adds the definitions:-

Efficiency is to do things right
Effectiveness is to do the right thing.

The session showed no doubt that the new technologies can speed up and assist information handling at all locations in the future but we need to ensure that all countries can enjoy the benefits equally.

Systems Developments - methods and instruments (Dr. Moller)

Nine delegates appeared as speakers at this session covering a number of topics related to Systems Developments. The first paper listed in the programme was not given since the authors, Drs. Thoma and Guy, were unable to come to Montreal. The full paper will be included in the Conference proceedings. Another paper was given not by the authors, Drs. Large and Armstrong, but graciously read by one of our colleague delegates, Dr. Fjallbrant.

The first papers dealt with optical disk technology such as ODIR (Optical Disk Information Retrieval), described by Dr. Appelrath, and interactive videodisc technology storing multimedia and multi-formatted information - visual, audio and textual (Mme. Jucquois-Delpierre). The PROJECT EMPEROR I, presented by

Dr. Chen, showed us a dazzling example of how communication technologies can provide information transfer in a way not previously possible. Another paper, given by Dr. Clark, gave a systematic presentation of the development of computer products using Chinese characters for an online Chinese text storage, retrieval and manipulation system. Implementation plans for large scale systems and documentation of the methodology was the subject of a paper by Dr. Freeman, while two papers discussed the issues of users searching an online catalogue, and the fundamentals of browsing as a basis for the creation of an intelligent computer system to assist the user with retrieval. Boolean logic was the main theme of a paper, by de Stricker, which stressed the need for an environment that makes it difficult for the users to make mistakes and that, through new disc-based software, takes better advantage of the full power of the information services available to us today.

The last two papers dealt with downloading of quantities of data from an external host to an in-house micro-computer and the benefits and limitations of down-line loading of a microcomputer-based courseware authoring system from a minicomputer.

A subjective conclusion would be that a growing sophistication is evident in all the presentations. For decades one has seen rapid developments in computer technology and information transfer. It now seems that we are in an exciting period of rapid sophistication in all areas of library and information science, combined with increasing concern for the needs and capabilities of the users.

Coordination, Integration and Networking (Mrs. Launo and Professor Fujiwara)

The first speaker, Dr. Segal, described the factors playing a role in the centralisation/decentralization question. The factors were environmental, technological and configurational. He discussed also the factors militating against and in favour of centralization. Dr. Segal predicted continued use of centralized data-bases for cataloguing, growth of decentralized local projects and future linking via the OSI model, when it is further developed.

Mrs. Wu also highlighted the advantages of standards such as the Open Systems Interconnection (OSI) model. She described the automation of Agriculture Canada, both the library information system and management information system. The challenge lies in communication and linkages between these two distinct software and hardware configurations.

Mrs. Hasegawa spoke about the design and developmental methodology of a distributed network for chemical substances and bibliographic information. Several Japanese organizations participate in this project which aims at the sharing of data resources and their integrated use.

Dr. Scott spoke about OSI reference model to support computer communication in order to allow libraries to benefit from cooperation while allowing them the flexibility to develop their own systems at their own speed.

The Polish information system was described by Dr. Bankowski. The author proposed that the following actions be taken:-

- development of the information infrastructure;
- development of in-house product databases and specialized software;
- and the creation of model information centres.

China's information and documentation circle was examined in the paper of Messrs. Zeng and Zhao, which was presented by Mr. Huang. It was recommended that a national online retrieval system be developed with a distributed network with autonomous sub-systems as its modes.

The USSR's national computerised STI system was described in Professor Mikhailov's paper, which was presented by Dr.Shcherbina-Samojlova. She discussed the plan to double the amount of information services and the need to solve semantic problems of information processing.

The session showed great expectations of OSI possibilities in information services as well as expectations in all the new information technologies in several countries' information infrastructures.

The second half of this session opened with a paper by Dr. Neal described the Library Information Access System (LAIS) at Pennsylvia State University. Basically it is a library rather than an information system (as were several other systems described during the Congress) covering cataloguing and processing, catalogue access circulation and management data. ORDERS on the other hand, described in a paper by Inose et al, stores both bibliographic and full text on optical disks.

The next papers described the current state of progress and future plans in India (Dr. Murthy), China (Mr. Gao), Africa (Mr. Asiedu), Arab Countries (Mr. Kindilchie) and Yugoslavia (Dr. Kojic-Bogdanovic). The paper by Mr. Asiedu was notable for discussing developments in a field other than science and technology. ANAI, which he described, is the African Network for Administrative Information.

The last paper of the session, by Mr. Tunis, gave an account of the complex scene of national and international standards, industry standards and codes of practice.

Technology Transfer (Messrs, Alvarez-Ossorio and Kirouac)

This session of the Congress on Technology Transfer was organized with special cooperation from the committee on Information for Industry, FID/II, and was divided into two parts, roughly corresponding to the morning and afternoon sessions.

The morning session dealt with papers of a general nature, starting with non-technical aspects of technology transfer. These include the socio-cultural environment in which technology transfer takes place and the human aspects of those who provide and those who receive technology, as in fact the difference between developed and developing countries is only qualitative. As Mrs. Farkas-Conn pointed out, training and cooperation are also two aspects which are much influenced by those psychological and social factors.

The legal aspect of technology transfer is another non-technical element which is often neglected in technical meetings. Some organizations, like OECD and the Council of Europe, have issued guidelines and recommendations concerning Transborder Data Flow. A review of those guidelines was presented by Dr. Szibbo with some consideration on the host country Canada. Mr. Hill reviewed the situation from the point of view of FID. He showed that it is important to consider the value of published information, of "documents" in its widest sense and illustrated the role the documentalist should play to help in the process of technology transfer. The point of view of engineers and technologists on the one hand and information specialists on the other could be complementary in the sense that engineers could define what information is needed for technology transfer and the information specialist would then study how to get it. In this context, FID has several important roles to play.

Besides FID, the general role of other international organizations, governmental and non-governmental, was examined by Mr. Vasarhelyi with special reference to the UN family. Within UNIDO, the Technological Information Bank, INTIB, has a prominent place. UNESCO, through its General Information Programme, is also very active. The role of IDRC and MINISIS was also reviewed by Gavin and Valantin.

To illustrate the roles of the technical libraries in the technology transfer process, an evaluation of the services of the Helsinki University of Technology Library was presented by Dr. Koskiala, with special reference to the demand received from the industrial sector in Finland.

In the afternoon session, the speakers (Adeyemi, Cunningham, Basilier, Raitt) covered a variety of sources and users, governmental, para governmental and private organizations. They described their services to small, medium and large industrial firms as well as to other users, for instance those in the field of agriculture (Harris and Pina).

In the examples of successful technology transfer, the speakers stressed the importance of direct face to face contact between the supplier of technology and the end user (Technonet, MINISIS, IDRC, etc). Another characteristic of the organizations involved in technology transfer is the cooperation with other groups or sources in developing countries as well as elsehwere. Several examples of North-South exchanges were given. Chico described Technonet operating in the Asia Pacific region and reported on successful South-South technology transfer, highlighting the desirability of such exchange.

There is clearly a role to play for the FID committee on Information for Industry especially in the field of technology transfer to developing countries because information and technology transfer are interwoven and such important factors in the development of local industry.

Organization of Information (Miss Keenan)

This session dealt specifically with the tools used to organize and exploit books and information - the Broad System of Ordering, the Dewey Decimal Classification and the Universal Decimal Classification (UDC). This session started appropriately with a memoire of Paul Otlet and Henri La Fontaine in a two minute description of the characteristics of FID's two founders. The historical development of classification systems was a main feature in the paper, by Mr. Batty, on the nature and development of multi-dimensional classification structures. At its close, the discussion was turning towards a wider debate on the application of a single model of a classification scheme which could be used for all subject areas at both the general and the specific level. There was also a need expressed for a concordance between classification systems.

The most recent information tool discussed was the Broad System of Ordering (BSO) which Mr. Stiles considered in terms of its usefulness in the development of expert systems. The paper, given on behalf of Mr. Coates, on lexical tools for information exchange in a mechanised environment, discussed the results of a referral test using the Broad System of Ordering as a search aid in an experiment on 38 databases in the DIALOG system performed by London University Centre for Information Services (LUCIS).

Although Mr. Paulson also made reference to the historical context by referring to conversations between Dewey and Otlet starting in 1895, the keyword for his presentation was "change". He described the methods of updating and revising the classification, the automated Editorial Support System and the use of the Dewey Decimal Classification in automated retrieval systems.

The paper, given by Ms. Markey, on library classification as a subject searcher's tool in an online catalogue, introduced two new acronyms, "SOC' and "DOC" - SOC being the subject catalogue without Dewey and DOC being the subject catalogue plus Dewey. Four libraries had participated in the study which had led to recommendations for better coding in the classification fields in the cataloguing record; the degree of usefulness of the Dewey classification in online catalogues; the need to make classification captions clearer to library users and library staff; and the need to add information on the classification authority file. The discussion of this paper focussed on training, criteria for success and ease of use.

Mr. Batty's paper on the nature and development of multi-dimensional classification structures had been intended as one of a set of four papers but, in the event, his paper had been the sole survivor of the planned set. He pointed to the need for maps to guide thinking - either as an aide memoire to known territory or as an introduction to new territory. It pointed out the value of classification in the development of expert systems which need syntactical rules and also need to control vocabularies. The paper suggested that the categories of ignorance need to be defined and, although rules exist to establish parameters of question asking, rules are needed to establish parameters for response although, to quote T.S. Eliot, "If we can state the question precisely, we already known the answer'.

The final paper, by Mr. Strachan, dealt with the Universal Decimal Classification and, again, "change" was the keyword - as managing for change was the paper's subtitle. The debt to Ranganathan was acknowledged, and the characteristics and procedures of the UDC were described. The current work and planned activities on the mechanisation of the UDC were covered, together with a survey of major revisions and language editions published recently. The UDC Management Study, completed in 1984, was mentioned and the next phase in the UDC development was discussed in terms of the appointment of the UDC Management Board, the two tier revision process based on Coordinating Revision Committees and the implementation of an action plan. The future of the UDC in terms of its management, mechanisation and intellectual authority was the main focus of the discussion. The UDC will have a role both in traditional library and information systems and in the development of knowledge-based and expert systems.

Finally, the session featured the announcement of the FID Classification Research Committee (FID/CR) Ranganathan Award of Merit to Pauline Atherton Cochrane for her contributions to classification research.

Final Summary (Mr. Hill)

In the closing session, the President drew attention to the wide range of important scientific and professional issues which had been addressed within the framework of the theme Information, Communications and Technology Transfer. Some speakers had reviewed the state of the art in their field of interest or the current state of development in their country and institution. Others had described new developments and put forward an indication of where present developments are leading. Presentations had been short and the time for formal discussions still shorter, but the opportunity to exchange ideas and experience between the experts present was clearly being taken.

The development of tools for the documentalist and better technical means of communicating had been nicely complemented by discussions on putting the information to practical use. It had been particularly encouraging to hear of progress in the developing countries, not just in traditional information services but also with the new technologies. In this progress the beneficient influence of UNESCO's PGI and that of other supportive agencies such as IDRC and CTA is apparent, as is the work of FID itself. Nevertheless, much remains to be done, in some countries very much more than in others.

FID's contribution to progress through the I&D profession will be mainly focussed on 5 major programmes:-

1. improving understanding of the properties of information, of its transfer and of its impact;
2. improving the availability and applicability of information resources;
3. achieving the maximum use of information services;
4. the development of tools, both intellectual and electronic, for the profession; and
5. professional development - especially education and training.

However, FID will be more flexible than hitherto and able to adjust readily to new areas of activity and to meet quickly new needs that arise. He referred to the new Task Force on Information Marketing and, the Special Interest Group (SIG) on Banking and on Software Evaluation, an expert workshop on Optical Disks and a suggested new SIG on Expert Systems in Classification and Indexing.

In summary, then, it had been a good, informative Congress which had signposted some paths to follow. He looked forward to the next Congress in Helsinki in 1988.

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LIBRARIES AS INNOVATIVE ORGANISATIONS: A REVIEW OF RELATED LITERATURE

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The concept of innovation as defined by classical innovation theorists such as Rogers, Shoemaker, Havelock and others are examined in general terms, and related to specific aspects of the theory and practice of modern librarianship. While the basic objective of this paper was to highlight the major trends in the innovating process in library organizations, it is argued that innovations as the introduction and application of new ideas, procedures or processes or the manufacture of new products is not new, the scientific study of such developments in libraries is however, a recent phenomenon. Efforts are made to collocate and thus familiarize interested scholars of library innovations with the literature reflecting the state of the art in this apparently new field.

The concept of innovation as viewed and studied from different perspectives has lent itself to a variety of definitions depending on the approach. It may be viewed by different disciplines and organizations with different perceptual prisms. In this paper, it is revealed that majority of the literature currently existing on the study of innovations are outside the field of library and information science. And this situation has been projected further by the absence of any acceptable theory of innovation in the field. This accounts for the fact that a great deal of concrete concepts and theories have been developed in other disciplines leading to even wider applications.

A few classical definitions of the concept will, however, be examined. One of the most often cited theorists of innovation is Rogers who views innovation as "an idea perceived as new by the individual"[1]. A more explicit definition was later given by Rogers and Shoemaker by defining the concept of innovation as "an idea, practice or object perceived as new by an individual' [2]. While the above definitions are basically the same, the one by Rogers and Shoemaker goes much further to explain that an innovation is not just an idea but also a change which could be substantial encompassing changes in practices, and the manufacture of products or objects. Lucas takes a more critical look at the concept by distinguishing between "hard innovations" and "soft innovations"[3]. In his view, public policy is an example of a soft innovation while a change to a completely new practice or the turning out of a new product by a manufacturing firm is hard innovation. Innovations from the above definitions, therefore, could be seen as a new idea, procedure or product usually involving substantial changes.

LIBRARIES AND INNOVATION

Innovations as new ideas, processes or products are not recent developments in libraries. In fact, it could be safely asserted that innovations are as old in libraries as libraries themselves. It is widely believed in library history that in the great ancient libraries of Egypt and Mesopotamia which dates back to about 3000 B.C., information resources of that period underwent a series of developments in the storage methods. Thus, library records at this time became popularly stored in paypyrus and clay tablets in Egypt and Mesopotamia respectively[4]. And we have since then continued to witness the transition of these information storage devices to the present day books along with other forms of electronic storage media such as magnetic disks, tapes, etc.

What could be viewed as relatively recent, however, is the scientific study of these developments in the form of innovations in libraries.

It was not until the last decade that scholars in the field of library and information science began to give serious thoughts to this emerging but important aspect of knowledge utilization. Technological advances and the development of theories of management science such as those developed by Frederick Taylor (1911), Gulick and Urwick (1937), March and Simon (1958), Etzioni (1964) and more recent works by Evans (1976) and Steward and Eastlick (1981)[5] have been instrumental to the awakening of thoughts and consequently to the quest for the scientific planning of different attributes of innovation in library administration.

RELEVANT CONCEPTS IN INNOVATION RESEARCH

Before actually looking at the literature on this topic, it will be worthwhile to examine some concepts that are pertinent to the study of innovations in organisations vis-a-vis libraries. These concepts could also be referred to as general variables upon which the successful implementation of any form of innovation in a library environment depends. And they include the concepts of actors, barriers to innovating and the development of strategies for successful implementation of innovations.

In order to carry out the process of introducing innovations into libraries or any organizations, some individuals termed actors within and outside that organization have to be actively involved in its planning and implementation.

The university library systems like many other organizations are organized along a hierarchical structure with different actors, i.e., libray staff and users possessing varying degrees of influence. The idea of influence calls for an active but meaningful role by all categories of university library staff and users in the innovating process. But studies have shown that this is not always the case in many innovative attempts.

Munson and Pelz[6] in one of their frameworks identified seven types of actors in any innovating process:

1. The source of the innovations, i.e., the innovator;
2. Managers who make top level decisions;
3. Workers;
4. Clients (i.e., the community of library users in the case of libraries);
5. Suppliers who provide the necessary support system;
6. Social controllers; and
7. Intermediaries.

The roles of the last two actors are usually not very pronounced in a university library situation since they would not normally involve outside persons in the decision making process except for consultancy services.

In any innovative attempts, there are barriers that have to be overcome. One of such observations was made by Argyris[7] when he observed some problems in introducing innovations from management perspective. He was of the view that when innovations are implemented only from the above, there could be the danger of mistrust and condemnation from the subordinates below. He, therefore, suggested the active participation of all actors in the innovating process. Zaltman, Duncan and Holbek[8] also focused on barriers as crucial variables in the innovating process in organizations. They observed that lack of clarity, skill and knowledge about an innovation, unavailability of required materials and equipment including certain organizational arrangements were the critical factors to the effective implementation of innovations. These observations support and reaffirm earlier observations by Havelock that there has been a real need for new ideas, and approach to introducing innovations along with the economic and organizational ability of organizations to utilise or act upon new knowledge[9].

Discussing his own view on this issue, Lindberg in a study identified sociological and behavioural factors apart from technological as also very crucial in determining an innovation's effective implementation [10].

As far back as 1969, Robert Chin and Kenneth Benne had already developed three major strategies which they believed could be applied to the innovating process. These include:

1. The emperical rational strategy;
2. The normative re-educative strategy; and
3. The power coercive strategy of effecting changes in an organization[11].

In his own approach Utterback focused on the influence of the organization's external environment and the former's ability to achieve the effectiveness of innovations[12]. Although the author did not make himself clear on this issue by pointing out specific cases of an external environment, it is true to a great extent that the nature of an organization's external environment could be a crucial factor in determining the effectiveness of its innovative efforts. He goes further to express the fears which could be generated about job security that changes in organizations could create. This is a very relevant point in current library practice where different forms of technologies are finding their way into such practices and supplanting older norms.

Glaser et al in their own view identified a set of strategies which they considered were conducive to successful innovation. These include:

> "... a climate of trust, critical information regarding anomalies, an incentive system, shared interest in solving common problems and a careful planning for structural changes or organizational rearrangements that require adoption of certain procedures or action"[13].

While Glaser and Baker still on this point see an alternative approach when innovations are introduced on a pilot basis[14]. Although this could be a feasible approach, its success will depend greatly on the nature of the innovations also. Glaser from another perspective emphasized variables such as integration, discussion, need, feedback, reward, adaptability etc. as having major effects on the analysis and durability of innovations[15].

The rational-social-interaction political strategy developed by Lindquist in 1978 emphasized on an integrated process of needs assessment, linkage of principal actors, open development and decision making with a support for the actual implementation of the innovation[16]. Innovations by their nature need to be introduced carefully if they are to achieve any appreciable success. Havelock in this regard warned about skipping any important phase in total implementation process[17].

Havelock in another work was more expansive than Lindquist's model by developing a more concrete set of strategies. He focused on perspectives to development, and knowledge utilization in planning innovations in social systems. His first strategy is the social interaction perspective whereby an innovation is brought to the attention of a potential user population. His second approach is the research, development and diffusion in which he emphasized change from the perspective of the originator. And the third approach is the problem solver perspective[18]. This approach basically emphasizes the process of change by first identifying an area of concern or by fulfilling a need for a change with a view to improving the effectiveness of such performance. For Havelock, this perspective primarily focusses attention on the user of the innovation. All of the above models have some relevance to library innovation but of particular significance in this paper are the problem solver and the social interaction models because of their emphasis on the innovating process in organizations. Also crucial is their emphasis on the users' need being of paramount importance coupled with a thorough diagnosis of the problem as part of the innovating process. Many innovations have been introduced into libraries without adequate analysis of the library's community of users as to whether or not such innovations are actually desired.

Gray in another classical model identified four different types of strategies in the process of introducing innovations. The first strategy according to him is (a) assistance strategies which in his view should provide technical or fiscal support for making organizational arrangements to receive and use the innovation; (b) educational strategies which provide individuals with information and training needed to use the innovation and integrate it into their routine performances; (c) power strategies which are supposed to be applied to establish rules and functions to force the innovation into operation and provide organizational control over its use, and finally (d) persuasive strategies that will shape people's attitudes and values to foster personal commitment to the innovation[19].

RELATED RESEARCH ON LIBRARY INNOVATIONS

It was reiterated earlier in this review that the literature on innovation research in librarianship has been relatively scanty. In fact, empirical studies in this aspect of librarianship started only during the past decade. This situation has called for more analytical studies of different kinds of innovations in library based systems of not only the developing countries but also of the developed countries. It is through such studies that the principles and theories of innovation applied to other disciplines and organization can also be applied to librarianship, and may be from there theories of innovation as applied to libraries will develop.

However, there have been some theoretical attempts to find out the nature of innovations in libraries. Attempts have also been made to identify their origins and the channels by which they are communicated and problems associated with them in different library environments. Perhaps Lucas' observation of innovating processes have some relevance to libraries. He was of the opinion that:

> '... it is not generally accepted that most developing nations have had difficulty in integrating the available technological and organizational policy innovation equated with modernization. Instead, most developing nations are seen as saturated by "dual" urban/rural political economies that frustrate adaptation and even effective trial adoption of innovative techniques and politics'[20].

Many scholars in library and information science have tried to relate the problem of innovating in libraries to a variety of factors like administrative, financial, social, technical and cultural. Recognizing these factors, Charles McClure[21] stressed the importance of an efficient planning process as a means of improving the effectiveness of innovations in library organizations. He went further to point out that most library managers give several irrational excuses for not planning. He identified these factors as too few staff; not enough time; too little money; dispersed geographical location; too many projects already in hand; etc.

With regard to managing innovations in libraries, Drake pointed out that certain factors are critical to efficient management of innovation particularly in academic libraries. The factors identified by her are as follows:

1. Performance gaps;
2. Incentives to innovate;
3. The nature of the innovation; and
4. The implementation of innovative strategies[22].

Furthermore, Drake expressed the optimism that:

> "If libraries are to continue their important contribution to the instructional and research missions of academic institutions, a climate conducive to change and generation of new ideas must be created"[23].

She thus warned that:

> "library administrators must view innovation seriously and provide followthrough to develop ideas into innovations that can be integrated into library operations"[24].

McClure[25] after a study conducted in 1980 supported the observation made earlier by Drake. He concluded that researchers must recognize certain factors that are crucial to the development and implementation of new ideas. In this regard, he identified variables such as the effectiveness of shared decision making, management styles, etc. He also stressed the importance of professional associations, communication channels and research activities of organizations as sources through which innovations can be introduced.

Drake and Olsen on the other hand focused on the economic aspects of library innovations. Focusing on university libraries, the authors defined their economic environment in terms of the following areas:

1. the external environment in which economic factors are beyond the immediate control of the library;

2. the university setting in which the library has importance and influence; and

3. the internal operational environment in which the library has varying degrees of control over the allocation of resources [26].

While it is becoming interesting to note the various discussions on the theoretical aspects of innovations in libraries, some writers still have certain reservations about the ability of libraries to embrace innovation. In this regard, Taylor's essay in which he focussed on whether or not libraries can adapt meaningfully to the number and rate of changes being faced cannot be ignored. He raised a crucial question which states :

> "Will innovation in present-day libraries change their objectives?"[27]

He went further to observe that most of the technology is available for large scale innovation in information disseminating institutions such as libraries. But that the problem is now that of acceptance, suitability, and adaptation.

A review of some empirical studies that have been conducted prove some of the above theoretical concepts in different directions. Thus, while some studies have been able to reaffirm some of these principles, others have not supported them. One of the early studies on innovations in libraries was Forman's study of innovative developments in 1193 liberal arts college libraries in 1967[28]. Innovations studies were various in nature ranging from change in administrative practices to automation. Given his limited objectives for the study and the limits of his research instruments, he could hardly conceptualize any theories from his findings. Nevertheless, the study revealed that libraries were already embracing general substantial changes.

In 1974, Dougherty and Bloomquist[29] published the results of an investigation conducted on centralized and decentralized library services at two universities and the reaction of the faculty to an innovative rapid delivery service of library materials to their offices. Results revealed that the new service was enthusiastically received at the university where it had been implemented and not at the other university where they were not adequately informed. They, therefore, concluded that personal experience or lack of it strongly affects one's perception and his/her subsequent evaluation of new services.

Dougherty[30] in another study tried to identify innovatives solutions to existing library organizational, bibliographical and service problems. This study was basically descriptive as no relationships were determined as in the case of Dougherty and Bloomquist. They nevertheless, provided some good work on which many subsequent empirical studies of innovation in libraries were based.

On perceptions and evaluations of innovative attempts in libraries, Berk did a study on an information innovation in a scientific community[31]. The study was concerned with the limited use of the MEDLARS demand service of the National Library of Medicine. The findings of this study suggested that there is a positive relationship between the level of knowledge of an innovation or its awareness and its adoption, thereby increases the effectiveness of such innovation.

Using a different methodology, Luquire conducted a study aimed at identifying the selected factors and variables that affect librarians' perception of the Ohio College Library centre as innovative project. Basing the findings, he concluded that :

> "technological change as a force in libraries must be coped with from the attitudinal or psychological point of view perhaps even more than from the technical approach"[32].

Luquire and Berk seem to agree on their findings that exposure to an innovation by its users have a great deal of influence on the latter's evaluation of such innovation. Luquire, however, goes further to substantiate the fact that some relationships exist between the rate of adoption and effectiveness of innovations. Whitemore conducted a study on user acceptance of microforms as innovative projects. The findings of the study revealed a positive correlation between knowledge of the innovation and its acceptance which goes further to reaffirm Beck and Luquire's earlier findings on the same issue.

Helen Howard[33] conducted a study on the relationship between certain organizational variables and the rate of innovation in selected university libraries in the United States. This study was built on the framework of an earlier study by Haye and Aikem[34] who field-tested some variables with a sample of sixteen social welfare agencies. The results of her findings showed positive relationships between complexity, professional training and the rate of innovation as the dependent variable.

Igwilo conducted a study on automated circulation systems in university libraries in Nigeria[35]. Although this investigator did not study automated circulation systems as an innovation per se, he did recognize the magnitude of the problem of introducing new ideas, products or procedures in university libraries. This was evidenced by his observation that:

> "it is necessary to understand the structure of the system and the forces of the environment to which it is subjected"[36].

He did not elaborate on this, but there is no doubt that he raised an important point which in turn gives rise to series of diffusion of innovations in university libraries.

It is clear from the above literature review that while some empirical studies have already been done on innovation in libraries, a great deal of research is still needed in this area. It is through these research studies that the library profession will be able to develop theories which will eventually lead to concrete principles and laws from where we can build upon. It is also very apparent that a majority of the theoretical concepts examined in this review have been developed by theorists outside the field of librarianship. We, therefore, do have an urgent need in the profession to develop our own concepts or adapt the current ones with greater relevance to the library situation. Furthermore, more empirical studies whether they are new or even replications of those already done either in librarianship or in other fields are needed. This approach will enable us to test the reliability and validity of concepts and methodologies already utilized in other fields to librarianship.

With the current pressures on libraries, particularly university libraries, for better services and performance measures amidst the current financial constraints and in some cases decreasing library budgets, it becomes all the more crucial that libraries have to seek changes to render their services in more cost-effective ways. In the area of technological innovations, it is hoped that as technology advances, the cost of introducing such innovations will decrease, if not in the short run, at least in the long run. But at the same time, libraries will have to plan efficiently to be able to face the challenges. The libraries of the developing countries have a greater task in this direction. More detailed studies in the area of library innovation are needed. The results from such studies will serve as indicators to be used by university libraries and administrators in planning the introduction of innovation into their library systems.

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INTERNATIONAL CHANNEL OF COMMUNICATION OF BIOPHYSICS LITERATURE

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Tracing the history of biophysics literature presents an analysis of 3515 citations published in 438 journals taking Annual Review of Biophysics Vol. 7 (1978) - Vol. 8 (1979) as source. The analysis reveals that 82.3% citations (i.e. 2893) are covered by first 100 journals and the rest of 17.7% citations (i.e. 624) are covered by the remaining 338 journals. Further analysis shows that primary journals account of 83.2% citations, non-primary serials cover 6.1% and non-serial publications account for the remaining 10.7% citations. A ranked-list of first 100 journals form the main communication channels and amongst other channels biochemistry journals dominate over other subjects. With regard to scatter 60% of significant literature of biophysics is covered by the first 25 journals only and the rest by 413 periodicals. The findings thus prove the validity of Sengupta's Law of Bibliometrics.

INTRODUCTION

Biophysics has a long history. Its origin has been dated with the origin of science. The pioneering studies of Leonardo da Vinci on the flight mechanism of birds in 1487 may be treated as an identifiable beginning of biophysical study. However, the origin of biophysics antedates the division of natural sciences into separate disciplines. Bioluminescence was among the most ancient objects of biophysical study. Athanasius Kircher, a 17th century German Jesuit priest, was perhaps the first who made scientific investigation on animal luminescence and devoted two chapters to bioluminescence in his book *Ars Magna Lucis et Umbrae*. The relation between electricity and biology attracted much attention in 17th century and was intensely explored in the 18th and 19th Century. Sir Isaac Newton observed in the *Principia* (1687) that "all sensation is excited and the members of animal bodies move at the command of the will, namely, by the variations of (a subtle) spirit, mutually propagated along the solid filaments of the nerves, from the outward organs of senses to the brain, and from the brain into the muscles." John Walsh in 1773 wrote to Benjamin Franklin about the details of his discovery of the electrical ray. It was characteristic of the unity of science then prevalent that advances in knowledge of bioelectric phenomena were sometimes made by professors of physics who were interested in biological phenomena or professors of anatomy, a subject that included physiology at that time.

These physicists and physiologists were attracted to biophysical research because of Luigi Galvani's remarkable discovery of bioelectricity where he showed excitability of frog muscle by application of electric current. Galvani's discovery may be considered as a landmark in the history of biophysics as many pioneers would consider Galvani's discovery of 1786 as the origin of biophysics as a subject. Lavoisier, a contemporary of Galvani, set the stage ready for metabolic research through his experimental work with animals. He showed that oxygen played a vital role in respiration and oxygen combustion resembled very much to that of physical combustion. Darwin, the first biological theoretician, put forward his theory on the origin and evolution of species which indirectly gave a tremendous boost to biophysical research. Thereafter considerable work in biophysics followed one after another concerning electrical stimulation of muscle, conduction of information by nerves by applying electric pulses, speculation on "nervous fluid" and the identity of "electrical matter" and "animal spirits", generation of force by contracting muscle etc. Considerable work in this direction was done by Du Bios-Reymod, the German electrophysiologist. Because of such biophysical research, disciplines like neurophysiology, electrophysiology became prominent research arena during the 19th century. Another landmark for the development of biophysical research was the study of diffusion gradients and osmotic pressure in the 19th century done by Abbe J A Nollet, Rene Dutrochet, W F P Pfeiffer, Adolph Fick, who wrote in 1856 *Die medizinische Physik,* probably the first complete biophysics text, Jcobus Van't Hoff, Wilhelm Ostwald, Francois Raoult and Svante Arrhenius. This century is also noteworthy for the unique contributions of Faraday, Herman Ludwig, Ferdinand von Helmholtz, Mendel, Flemming, Robbert Mayer, Tyndall, Willard Gibbs, Sir Jagadish Chandra Bose, and Rontgen which have greatly helped the growth of biophysical research. Faraday laid the foundation of modern electrochemistry and electrobiology. Helmholtz's made significant contributions on sense organs mainly physics of colour vision and hearing which has formed the basis of modern colour perception.

Mendel's rules of heredity and Flemming's concept on chromosomes have been in 1960s identified with molecular structures and processes. Gibbs applied thermodynamics in biological system, while Rontgen discovered X-ray which later remarkably helped to the growth of biophysical research. Robert Mayer, world's first real biophysicist, perceived that the process of metabolism involves a considerable turnover in material from one chemical state to another and that some mechanical work is involved in the process. He intuitively accepted the principle of the conservation of energy in biological systems. Tyndall applied his discovery of the scattering of light by submicroscopic objects to verify Pastuer's ideas of bacterial action. Physicist Sir J C Bose, is considered as the first fulfledged biophysicist of the current century as most of his biophysical theories were developed during the period 1902-1933. This pioneer Indian biophysicist systematically applied the concepts and techniques of physics to study the responses of plants to external stimuli. His book *Electrophysiology: A physico-physiological study,* London, 1907 is one of the few books on biophysics that were published during.the first decade of this century. Sir Bose devised various inorganic models of biophysical phenomena underlying mechanical and electrical response to stimulation, transmission of excitation in plant and animal tissues and models of vision and memory.

It is of interest to note that from the time of these great earlier biophysicists till about 1930 research interest in biophysics was at a low ebb, perhaps because of greater attraction of fundamental physics which was making great strides during this period. However, interest in biophysical studies again revived around 1930 when A V Hill started his study of thermal and energy effects in muscle. Contributions of Sir Henry and Sir Lawrence Bragg paved the way for research in molecular structure of biological macromolecules in 1960s. Also Peter Debye and Irving Langmuir are outstanding contributors in modern biophysical chemistry and membrane problems. X-ray deffraction studies of biological macromolecules pioneered by Astbury using simple X-ray diffraction analysis resulted in the discovery of the three forms of fibrous proteins. The follow up research of Astbury led to fundamental advances in knowledge of the three dimensional structures and physical basis of the biological activity of proteins, enzymes and hormones like insulin, haemoglobin, myoglobin lysozyme and ribo-nuclease. During this decade the studies of Gates, Heclit, Lofbourow and Holiday and Caspersson respectively on biological action spectra, sensitivity of the eye, adsorption spectra of newly purified biological molecules and differential absorption of protein and nucleic acid to show their inter-relationships in the living cell are considered most significant. During 1940s War had its effects on biophysical research, even though it was an active field of research and it again gained momentum during middle of this decade.

It may be relevant to mention here that the ideas and techniques of chemistry were systematically applied to the study of living matter for the first time in the 1870s with the consequent emergence of biochemistry as a separate scientific discipline. Similarly during the 1950s and 1960s the ideas and techniques of physics began to be systematically applied in the field of biology setting off a rapid and large increase of research activity in the field of biophysics and molecular biology. As a result biophysics emerged and matured as a distinctive discipline of science during the past few decades. During this period new techniques and discoveries followed one another attracting more and more research workers to this new and prestigious area of research. Among the outstanding researchers of this period mention must be made of the Nobel laureates Sir Crick, Watson, Jacob, Monod, Pauling, Wilkins, von Bekesy, Calvin, Kendrew, Perutz, Huxley and Hodgkin who are noted for their epoch making interdisciplinary biophysical contributions.

The sudden increase in research tempo brought out new concepts and ideas, and a flood of papers started pouring in for publication. In any branch of science, journals begin to appear only when that branch starts to get recognition as a separate and distinctive discipline. Generally the growth in the number of journals in any area of science accurately reflects the growth of knoledge in that area. However, the growth in the number of scientific periodicals in any scientific discipline takes place in three stages namely (i) increase in size and volume of existing periodicals; (ii) inception of new journals for publication of research result from new geographical areas where interest in the new branch of science has become widespread; and (iii) establishment of new periodicals to cover special areas of the scientific discipline which assume importance as a result of increasing specialisation.

It is interesting to note that *World List of Scientific Periodicals* records *Biophysikalische Zentralblatt* as the oldest secondary periodical in the field of biophysics. It was launched in Berlin in 1905 which later became *Zentrablatt fur Biochemie und Biophysik* in 1910. However the first primary journal in the field was *Biodynamica.* It appeared from Monona Drive, Madison, Wisconsin, U.S.A. in the year 1934. Because of the historical interrelationship between the subjects of biophemistry and biophysics, several titles figuring in the literature of biophysics are journals of combination type covering both biochemistry and biophysics. The first journal of this type to be established was *Biochimica et Biophysica Acta* published from The Netherlands since 1947.

Data compiled in the *World List of Scientific Periodicals* (fourth ed. and 1968 supplement) and *Ulrich's Periodicals Directory* (21st ed., 1982) show that the number of primary biophysical journals increased from one in 1934 to eight in 1950, twenty-seven in 1960, fifty in 1970 and seventy-eight in 1980. As a result of the accelerated growth of biophysics journals, working biophysicists find themselves buried amidst pile of unread articles. To make matter worse, large number of important articles in the field continue to appear in periodicals of general sciences (like *Nature, Science,* and *Proc. Nat. Acad. Sci.*) and in specialist periodicals in areas like biochemistry, physiology, neuroscience, virology and physics.

METHODOLOGY

It has become necessary to have an objective means of identifying the factors responsible for the sudden growth of literature in the field of biophysics and to know the international chennel of communication of biophysics literature and their relative importance from the point of view of biophysicists, and librarians and information scientists attached to biophysics research institutes. The enormous growth of literature in the field and also wide scattering of biophysics literature in journals of different subjects has created great problem in tracking the significant literature of the subject. To cope with the unprecedented growth literature, a new bibliometric technique[1] developed and used in Sengupta's work, has been followed to identify scientific periodicals in the field of biophysics which will not only help the concerned librarians to utilize their library budget to the best advantage of their users, but also save the valuable time of the working research-scientists in the field by discarding the relatively less important journals from their regular reading list. With this object in mind we have identified 498 journals that cover the maximum segment of contemporary biophysics literature. This quantitative evaluation is based on 3517 citations collected from the source journal, *Annual Review of Bio-Physics* volumes 7 and 8, 1978 and 1979. Advantage of using Annual Reviews as source journals has been elaborately discussed by Sengupta[2] earlier. These 438 periodicals of different subjects, today act as the main channel of communication of biophysics literature. However, we have included the first 100 journals in Table 1 covering 82.3% of total citations and excluded the remaining 338 journals as they only cover 17.7% of total citations. This has been done in order to avoid making Table 1 unduly lengthy. Other channels of communication identified in our study are non-primary serial publications, such as books and monographs, theses and dissertations, and miscellaneous items, namely, personal communications, unpublished experimental data and patents.

DISCUSSION

Primary journals accounted for 83.2% of all citations counted, while non-primary serial publications cover 6.1% and non-serial publications accounted for 10.7%. This confirms the importance of serial publications in the present-day biophysical research. Percentwise distributions of different items of non-serial publications are: books and monographs 7.4%, theses and dissertations 0.9%, and others 2.4%. Thus, among the non-serial publications, books and monographs contribute maximum citations. But it is insignificant in comparison with primary serial publications. This fact undoubtedly reflects the comparatively lesser importance of books and monographs to the research workers of biophysics. However, this statement needs to be qualified to some extent. The fact that macrodocuments become obsolete soon after their publication may perhaps be the main reason for their infrequent use among research workers in the field of biophysics.

In this study 438 primary journals covering 3517 citations were noted. Among these titles the first hundred titles are listed in Table 1.

The striking feature of our study is the high status of multidisciplinary science journals like *Proc. natn. Acad. Sci., Nature, Science* in the communication channel of biophysics literature. This may be evident from the fact that these journals have occupied the topmost positions in Table 1 (vide ranks 1, 4 and 7). The reasons for this may be interpreted as the importance and relevance of biophysical contributions in the overall growth of knowledge of significance to science as a whole.

From the table it will also be seen that journals in the field of biochemistry predominate over journals of other fields. This is indicative of the fact that biophysicists of today prefer biochemistry periodicals as a good channel of communication for their experimental results. Absence of many biophysics periodicals, exclusively devoted to this subject, in the communication channel of biophysics literature is somewhat unexpected. Many biophysics journals established in the sixties, following the sudden efflorescence of interest in the subject triggered by Watson[3] and Crick's discovery of the structure of DNA on the one hand and the X-ray crystallographic studies of Kendrew[4] and Perutz[5] leading to the elucidation of the three-dimensional structure of biologically active proteins on the other. From the predominant position of biochemical journals in Table 1, it seems evident that the techniques and concepts of biophysics have become integrated with the general body of biochemical knowledge and methodology, and biophysics, instead of growing as an independent discipline, is gradually merging into the discipline of biochemistry. Moreover, the predominance of biochemical periodicals in the communication channel of biophysics brings out a fact which may be of special interest to the scientometrists who are interested in the study of history of science. The rapid accumulation of knowledge in the field of biophysics has catalysed a change in the infrastructure and direction of growth of biochemistry to such effective purpose that biochemistry has become established as a viable tool for the study of

Table 1

Communication Channel of Biophysics Literature

Rank	Name of Journal	No. of citation
1	Proc.natn.Acad.Sci., U.S.A.	243
2	J. Physiol., Lond.	237
3	Biochemistry, N.Y.	164
4	Nature, Lond.	150
5	Biochim. biophys. Acta	142
6	J. biol. Chem.	110
7	Science, N.Y.	100
8	J. molec. Biol.	98
9	J. Cell Biol.	83
10	J. gen. Physiol.	76
11	J. Virol.	66
12	Virology	63
13	Brain Res.	60
14	J. Am. chem. Soc	58
15	F E B S Lett.	56
16	J. Histochem. Cytochem.	55
17	Biophys. J.	53
18	Biochem. biophys. Res. Commun.	51
19	Expl. Cell. Res.	37
20	Eur. J. Biochem.	33
21.	Photochem. Photobiol.	32
22	J. Neurochem.	27
22	Proc. R. Soc. Lond. Ser. B.	27
24	Ann. hum. Genet.	25
25	Ann. N.Y. Acad. Sci.	22
26	A. Rev. Biophys. Bioengng	21
26	Cold Spring Harb.Symp. quant.Biol.	21
26	J. exp. Biol.	21
29	J. comp. Physiol.	20
29	J. Neurobiol.	20
31	A. Rev. Biochem.	18
31	Am. J. hum. Genet.	18
31	Chem Phys. Lett.	18
31	Fedn.Proc.Fedn. Am. Socs.exp.Biol.	18
35	Protoplasma	17
36	Inst. elect. Electron. Engrs. Trans. Biomed. Engng.	16
36	J. cell. Physiol.	16
36	J. Member. Biol.	16
39	Biochem. J.	15
39	J. phys. Chem.	15
41	Am. J. Physiol.	14
41	Devl. Biol.	14
41	J. gen. Virol.	14
41	J. Neurophysiol.	14
41	J. supramolec. Struct.	14
41	J. theor. Biol.	14
41	Nucleic Acids Res.	14
41	Biol. Bull. mar. biol. Lab. Woods Hole	14
49	Cell	13
49	J. comp. Neurol.	13
49	Vision Res.	13
52	J. Biochem., Tokyo	12
52	J. chem. Phys.	12
52	J. Protozool.	12
52	Planta	12
56	Biochem. Soc. Trans.	11
56	Electroencephalogr. clin. Neurophysiol.	11
56	Phil. Trans. R. Soc., Lond.	11
56	Proc. Inst. elect. Electron Engrs.	11
60	Biometrics	10
60	Biopolymers	10
60	Cancer Res.	10
60	J. Ultrastruct. Res.	10
60	Rev. sci. Instru.	10
65	Acta. cytol.	9
65	J. clin. Invest.	9
65	J. Neurosurg.	9
65	Physiol. Rev.	9
65	Proc. Jap. Acad.	9
65	Q. Rev. Biophys.	9
71	Acta Protozool.	8
71	Archs Microbiol.	8
71	Cell Tissue Res.	8
71	Comp. Biochem. Physiol.	8
71	Dev. Growth Diff.	8
71	J. Cell Sci.	8
71	J. exp. Zool.	8
71	Life Sci.	8
71	Neurosci. Abstr.	8
71	Phys. Rev.	8
81	A. Rev. Pl. Physiol.	7

Rank	Name of Journal	No. of citation
81	Acct. chem. Res.	7
81	Acta physiol. scand.	7
81	Archs Biochem. Biophys.	7
81	Biomed. Sci. Instru.	7
81	Comput. J.	7
81	Expl Neurol.	7
81	Meth. Enzym.	7
81	Symp. Soc. exp. Biol.	7
90	Analyt. Biochem.	6
90	Biofizica	6
90	Bot. Maq.	6
90	Brain Behav. Evol.	6
90	Brookhaven Symp. Biol.	6
90	Comput. Biomed. Res.	6
90	Hum. Hered.	6
90	J. nucl. Med.	6
90	Math. Biosci.	6
90	Med. biol. Engng. Comput.	6
90	Pflugers Archs; Euro. J. Physiol.	6
First 100 journals cover	2893 (82.3%) of total citations	
Other 338 journals cover	624 (17.7%) of total citations	
G.T. 438 journals altogether cover		3517

biophysical phenomena at the molecular and submolecular level equally employing the techniques of chemistry and physics. This trend is further evident from the emergence of special areas of research like molecular genetics, molecular medicine and molecular pathology which are cognate to biochemistry rather than biophysics.

Journals of virology (vide ranks 11 and 12) also form a high communication channel for biophysics literature. This is obviously due to the importance of viruses as research tools in the experimental approach to the study of molecular biology.

Physiology journals (vide rank nos. 2 and 10) also appear as another potential medium for the dissemination of biophysics research results. This is perhaps due to increasing trend of research in electrophysiology, harnessing new developments in electrical and electronic technology. To some extent for a similar reason neuroscience journals (vide rank nos. 13, 22, 26) are chosen as one of the preferred media for communication by the biophysicists of the world. Today a good deal of research at molecular level is done by the biophysicists with the help of sophisticated instruments like electron microscope. The results of such microscopic studies are preferably communicated through journals devoted to biological sciences (microscopy). This explains high ranking of journals like *J.Histochem. Cytochem.* (rank 16), *Expl. Cell Res.* (rank 19), *J. supramolec. Struct.* (rank 41) and *J. Ultrastruct. Res.* (rank 60). Another striking feature of this study is that the significant literature of biophysics appears to be more widely scattered in journals devoted to different disciplines as compared to other biomedical disciplines. The wide scatter of the literature of biophysics is remarkable, extending as it does from psychology to agriculture. This is but proof of the premise of the biophysical approach for the solution of hitherto intractable problems of the diverse disciplines of biology, pure and applied. Analysis of all the 438 periodicals which we have identified as the media for dissemination of present-day biophysical knowledge, show that the main communication channels rest on journals in eight broad disciplines namely

(a) biochemistry (21.2%)
(b) science, general (15.8%)
(c) biological sciences : microscopy, general and experimental (8.1% + 3.7% + 1.6% respectively, i.e. 13.4%)
(d) physiology (11.3%)
(e) biophysics (7.2%)
(f) neuroscience (6.4%)
(g) chemistry (4.6%) and
(h) virology (4.1%).

Journals belonging to these eight disciplines are the main channels of communication of biophysics literature. They altogether cover 84% of total literature published in serial publications. Remaining 16% literature are disseminated through journals of 16 other disciplines, namely, psychology, mathematics, statistics, computer science, physics, geophysics, genetics, microbiology, bioengineering, botany, plant physiology, zoology, pharmacology, medicine (general), medicine (specialities) and agriculture. Thus this seemingly formidable scatter is not of much consequence to the research workers of biophysics or to concerned information scientists, because nearly 60% of the significant literature of biophysics is covered by the first 25 journals only. Remaining 40% literature is covered by 413 periodicals. Further analysis reveals that 50 and 100 journals nearly cover 70% and 82% of total biophysics literature. If we analyse the subject affiliations of the journals of the most productive nuclear zone and that of other less productive zones, it will be seen that our findings again forcefully prove the validity of Sengupta's Law of Bibliometrics, i.e., 'During phases of rapid and vigorous growth of knowledge in a scientific discipline, articles of interest to that discipline appear in increasing numbers in periodicals, distant from that field'[1]. That is, during such phases, the small group of journals accounting for the large part of significant literature in the subject contain a relatively larger proportion of unrelated journals. This is evident from the fact that only 3.7% of the total journals of the communication channel of biophysics relate exclusively to biophysics and cover only 7.3% of the total literature of biophysics which is a rapidly growing subject because of its direct involvement and relevance to molecular biology research.

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INFORMATION INDISCIPLINE

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Information is being produced at an ever increasing rate. Out of this enormous abundance of information production, roughly 50 per cent is redundant. There is pollution of information due to uncontrolled starting of new publications. Publication of "rejected papers" through monopoly journals has created imbalances and indiscipline. Duplication, debasement of quality, restriction of documents, misleading titles, unplanned and uncoordinated and piecemeal growth of secondary periodicals are the major factors leading to information indiscipline. The rapid growth of page charge system and enforcement of condition of membership to publish articles in some journals are leading to the emergence of a single body of contributors, irrespective of the merit of the papers.

PRELUDE

Information is a large and imprecise concept, and one that is almost impossible to define. Every innovation, in fact every new condition or situation, can originate scientific/business/administration/technical activity, and hence the need for information. Communication of information is a noble profession and as philosophically expressed by Manu, a great thinker of India, is a great service too. From time immemorial this process is being continued, but with a degree and difference of time and speed. Although the progress of science was slow in the beginning, it accelerated considerably with the invention of papermaking in the year 105 A.D. The spread of this knowledge to Central Asia and Europe by 750 A.D. is considered a landmark and during 750 A.D. to 1450 A.D. there was a substantial increase in the number of significant contributions.

The invention of printing machine using movable metallic types in the mid-fifteenth century and the establishment of the paper mill had a tremendous impact on the publication of literature in general. The position improved further with the emergence of learned societies and periodicals in the second half of the eighteenth century. The development of newer bibliographic techniques and tools in the last quarter of the 19th century resulted in further increase in the number of contributions in a short span of time. It is a great task to assess the value of information without losing the spirit of knowledge and distributing the balance of discipline in the flow of information. The objective of this article is to pinpoint the indiscipline in the production of information and not in the discipline of information science, as such.

INFORMATION FLOW

In recent years there has been a very large increase in the output of both scientific and non-scientific knowledge. The increase has outstripped the retrieval capacity of even the scholars in their own fields of study. There are at present fifty to sixty thousand current scientific/technical journals. Three new ones appear and one disappears every day. Production per scientist for each country and through time is fairly constant. Most of the papers are transient and about a quarter of them are never cited; about 98 per cent are completely forgotten after 10 years. A small number of journals in a particular discipline contain the most relevant articles on a subject. It is estimated that there are about 12 million research workers in the world and they produce about 2 million papers per year[2]. It is, therefore, realised that 20% of scientists induce 80 per cent of all papers in general as well as in particular disciplines.

There is evidence that scientists spend as much as one-third of their working lives in scientific communication, half of which is oral and the rest written. A part of the written communication is in the form of unpublished material. There is need for extensive evaluation, before original ideas are published.

EFFICACY

With rapid accumulation of knowledge (wanted and not wanted) comes greater responsibility of choosing disciplined information for application. Approximately fifty per cent of the knowledge produced, at the global level, is redundant. It is indeed the task of the reviewer and the editor to eliminate whatever is not relevant or accurate so that the reader gets only what he needs. Apart from the established disciplines, there is an indiscriminate flow of information in multi-disciplinary technologies. This makes it difficult to take care of overlapping disciplinary interests. It is interesting that the established discplines do not remain static and there is certain to be a continuous flow of new materials not wholly relevant to the present framework of publications. Under such circumstances, the flow of information is likely to become indisciplined. Some of the factors responsible for causing information indiscipline are discussed in this paper.

MONOPOLY JOURNALS

In the domain of scientific communication, the primary function of an ordinary scientific paper is to bring into the public domain an explicit account of some new scientific development or discovery. It is a rather contrived document, very conventional in form and style, whose purpose is to convince the general scientific community that the author's new observations or arguments are of interest, significance and permanent validity. The whole activity of science is dependent upon the publication of such documents and their subsequent criticism, revaluation and eventual acceptance of rejection as parts of the consensus of "public knowledge"[6].

The aim of all this is to ensure that there is some sort of discipline in the production of information. However, the actual situation is rather unsatisfactory. There are a number of journals which are the monopoly of certain associations controlled by individuals who treat their vested interest as more important than the purpose of science. Thus, when many of the articles of some authors are rejected by eminent and critical editors or reviewers, this is taken as a matter of prestige by the concerned authors and they insist on publishing the same articles by creating separate journals through some association or by a band of supporters, friends or subordinates dictating their positions. Such flow of information, indicative of pseudo-reflection of their position in the scientific community, finds its way into secondary periodicals. Accumulation of such pseudoinformation hastens the growth of the reservoirs of information. This practice of running monopoly journals is creating indiscipline in the flow of information, and it is not easy to control it; it functions as a vicious circle. Such journals are being patronised by a few individuals who manage positions. Attempts to establish credibility for biased research is the major consequence of this indiscipline.

QUALITY OF PUBLICATIONS

Because of scientific advancement, an enormous volume of information flows through various media, such as reprints, reviews, advisory publications, technical notes, technical reports, monographs, theses, reports, proceedings etc. Ephemeral literature, though appearing to be of transitory value needs to be preserved for some time till the value of the findings is disproved or approved or brought into a sound technical write-up or in book form. This is a time-consuming affair. Nobody can fix up a time limit for the taking the form of an end product. It flows till it is accepted or rejected, enlarging the scope for the production of pseudoinformation. Some sort of ambiguity creeps in during information flow causing indiscipline.

Unmanageable growth of science too results in the debasement of the critieria for quality publication. Along with scientific work of merit, some pseudo-scientific results are also obtained and attempt is made to get such work recognised through its publication. Unless the work is published in quality journals, its publication is meaningless. Any other mode of publication except in a quality journal, means a second rate publication. Such second rate publications may get printed or duplicated as "technical report", or "pre-prints" and may get into circulation. This affects the referee system, however hard the editors may try to keep their standard and esteem high. As a result, a vast sea of semi-scientific, half-baked and trivial material creeps in creating indisciplines.

AMBIGUITY

Striking a philosophic note, Lewis Thomas makes the following point in his essay entitled Language and human communication[4].

Ambiguity is an indispensable element for the transfer of information from one point to another where matters of real value are concerned. For meaning to come through, there has to be a vague sense of strangeness and askewness... When a bee is tracing sugar by polarised light, observing the sun as though consulting its watch, it does not veer away to discover an exciting marvel of .. flower, only the human is designed to work this way, programmes to drift away in the presence of locked-on information, straying from each point in a hunt for a better, different point. Till the cream of innovation is established, its peripheral explanation persists with supporting ideas making the information to flow whether it is needed or not.

RESTRICTION OF DOCUMENTS

Some developed countries are treating specific important information as their personal property, it is published in documents with restricted circulation. Mostly such information as is old and obsolete is released as "information for use' . This monopolistic attitude has created an anarchy in the information field and led to indiscipline of information. Many international organisations like UNISIST and COSTED are trying their best to explore the possibility of making information as liberated as possible and available for universal access, without much success. Certain developed countries are treating information as the "material art" of their own. "Information is, but not available for common use" has become the slogan of the day.

DUPLICATION

A major problem is associated with the duplication of information. It is the major hurdle in most of the LDCs (=Less Developing Countries) for want of systematic communication channels or lack of organisational set-up. Manpower, money and time are being spent with painful results. The problems are largely matters of communication, failure in which is at the best tiresome and at worst dangerous. Particularly the information found in foreign languages other than English is a matter of great concern.

MISLEADING TITLES

A large quantity of literature, particularly in agricultural sciences, is being published under obscure or misleading titles which do not see the light of the day even though they constitute first rate information. This adds to the indiscipline in production of information.

CONVENTIONAL COMMUNICATION

One of the primary functions of the conventional system of science is losing weight. The necessity of maintaining an open market for the creation of the individual scholar, as objective evidence of achievement and promise, is no longer evident. The tendency towards team work is growing fast. The impact of industrialization on information production has changed the outlook of research. The discovery that arises from it, is not a product of the ingenuity of a single mind, but of a large group, whose members specialise in different aspects and finally interpret the results. The evidence for this multiple effort is the multiple authorship of the paper; the results are reported with a dozen names appended to the publication. The individual skills required may be of the highest order, but the "productivity' or "creativity" of each participant is merged into the collective mind of the team.

PROLIFERATION OF SECONDARY PERIODICALS

According to Line[2], "the number of indexing and abstracting journals or journals containing index or abstracts sections is now about 3,000 - this was the number of primary journals 100 years ago. The expansion of recorded knowledge on the one hand and increasing pressures on the time of users on the other, have stimulated the growth of secondary tools - an almost totally unplanned, uncoordinated and piecemeal growth which institutions and governments have fostered for the best of reasons, and publishers for less altruistic reasons". The growth of secondary tools has solved nothing at all except serving the needs of a small group of people. They do not even attempt to supersede or compete with the earlier system. They have added to the number of systems to be used by the individual. But if he uses several, he will find a lot of same references cropping up in all of them, so that each additional one he uses brings less reward for his effort. Moreover, even if he uses ten or even more references, he will still miss something. On the other hand, if he acts as if the new system does supersede others, he will miss a great deal, perhaps more than 50% of relevant material.

Even the modern "current awareness" services are not very well-organized and normally a journal has to be read right through to make sure that one has not lost anything. If there is any delay, catching up is laborious. In the case of inter-disciplinary subjects, one has to make use of 2-3 current contents journals. So the indiscipline encountered in secondary periodicals too needs thorough examination.

INFORMATION CRISIS

The scientific community has seldom recognised the crisis of information production caused by rapid structural changes in it. Before the industrialisation of science, the bulk of the scientific research was done by university teachers, not as an explicit part of their employment, but as a semi-independent, personally directed activity, motivated by the desire for further preferment as a reward for scholarly prowess. But recently the outlook of scientific research has changed with major shift in emphssis from solo research to team research.

The discovery that arises is not a product of ingenuity of a single mind, but of a large group, whose members specialize in different aspects. This is the result of inter-mixing of different achievements of subjects creating a sort of indiscipline of information in the process.

CLEAN INFORMATION

A scientific publication is an evidence of registration of priority of discovery. Such type of information needs to be clean, in standard form, well-filtered, safely worded and ready for use. As a matter of routine vast quantities of unwanted information are resulting from scientific experimentation. It requires filtering and purification before the information can be put to use!

BUREAUCRACY OF SCIENCE

A parallel development is the rapid growth of the page-charge system or the condition of membership for accepting research articles in journals of repute. Publication is part of the overall research activity and such conditions imposed on the scientific activity are highly deplorable. Particularly they impose a great burden on the Less Developing Countries. This bureaucratic attitude on the part of the developed countries is another form of indiscipline of information.

The argument given for the imposition of such conditions is that it is done to get quality papers. But very often it prevents good papers from seeing the light of the day and results in their getting squeezed out. This clearly amounts to a sort of monopoly of some rich countributors.

MONOPOLY OF PUBLISHERS

The decision to support publications rests with the higher authorities rather than the persons who really do research! Good financial position seems inevitable when the condition of page-charge is imposed; as a result, only the work of the people who have become members of the society or who are able to pay the page charge, will be accepted. The institution from which research papers emanate must fully control the purity of such publications.

The position and the role of referee as a professional critic is most important. It is assumed by many that the review of the publication should be performed mainly within the producing laboratories, or even within the research team itself. The job of the referee is to confirm that the work is scientifically interesting, original, reasonably well-expressed and not vitiated by obvious errors. One should not be carried away with the notion that it is the function of the editor alone to guarantee complete scientific validity of every paper that gets published.

There are instances where, pressure is exerted by the leader of the research group to put their names to the work which they are quite unaware of. There are some example wherein the name of some famous scholars is sufficient to blind the anonymous refereess to the weakness of his argument. In this way also, information indiscipline is diffused into the network of production of information. A "house journal" edited internally is another example of monopoly of publication.

As per general principles, science is public knowledge and the activity of the reviewer is quite as important to the scientific community as the making of "original discoveries".

REPORT LITERATURE

The growth of report literature and the number of agencies involved in their publication have forced the scientist to pay for reading the same article once again only a few months later in a regular journal. The pressure to publish more in number, for professional prestige and preferment, is creating a sort of information indiscipline, which is highly deleterious to the scientific community, in as much as multiple publication of the same basic research is leading to degradation of standards and clogging of information channels.

Some of the conventional abstracting journals, such as *Chemical Abstracts, Metallurgical Abstracts,* etc., now include a limited number of reports, unfortunately the references are not always complete and this can create problems. For examples, DMTC reviews of recent development, regularly listed there, has a limited distribution and is not available to the general public. This is not mentioned in the abstract.

PARAMETERS FOR DISCIPLINING INFORMATION

With all the observations made and surveyed regarding the indiscipline in information it can be said that a great deal of scientific literature needs value judgement rather than basic data. The only reply to this question is skilled editing plus the direction and advice of a board made up of the most knowledgeable individuals in the field. To a certain extent, authors are also to be blamed; they must avoid giving misleading titles and also keep up the standard of the publication with due regard to science.

ETHICS

The pursuit of understanding and the advocacy of information-promoting activity will not solve the vexing ethical questions unless self-discipline is exhibited by the individual concerned; this will benefit information production as a whole. A commitment of scientists to prevent unhealthy traditions, would help to convince the public that they are not catering to just a few and to their own ego but they follow a code of conduct in the scientific community at-large. Strict adherence to ethics can prevent this indiscipline; otherwise the process is going to distort the entire concept of information. Indifference on the part of scientists (producers of information) towards observing a proper code of conduct in publication leads to anarchy and the public loses confidence in the scientific community. Self-consciousness is the only remedy and for this self-introspection by the individual scientists is an absolute necessity.

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SERIALS CONTROL USING NETWORK MODEL BASED DATABASE MANAGEMENT SYSTEM

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Discusses the schema definition of serials control database and the logical reasoning underlying the entities and relationships as well as the various factors influencing the physical representation of the logical schema with respect to Data Management System 1100 of Sperry Univac on which the database is implemented. Database loading and applications are also outlined.

INTRODUCTION

Among the functions of library automation, serials control is comparatively simple and offers a variety of substantial benefits, because of its less diversified transactions and recurring nature as opposed to other systems, especially the acquisition system. Monographs are ordered, paid for and received, and there ends a transaction of a particular item. On the other hand, serials continue to be ordered, paid for, received and holdings are updated repeatedly. Prompt claiming of missing issues is the crucial and the most time consuming task in the manual process. Claiming stems from three distinct roots – ineffective subscription, missing gap issues and issues that stopped coming altogether. The ease of controlling all these complexities is not the only attraction of serials control automation, it also offers many facilities such as routing slips generation (intimation to the selective groups of users about the arrival of journals of their interest), production of hard copy of holdings for use at reference desk and performance analysis of total subscription for management.

Choice between the use of procedural language and non-procedural language essentially lies in the complexity of the information structure which evolves with the application. A number of significant benefits can be realized in applying Database Management System (DBMS) for serials control. Koenig presented an extensive analysis of the use of DBMS packages of different data models in bibliographic information handling[1]. The work reported here applies the Data Management System 1100 (DMS-1100) of SPERRY UNIVAC 1100 series computers, which is based on CODASYL (Conference on Data System Language) approach[2].

SCHEMA DESCRIPTION

Database design, in general, refers to the process of arranging the data aggregates needed by application programs in an organized structure. It has two distinct parts – logical database design and physical database design[3]. The logical database can be considered a model of the real world system. Despite the fact that the logical database design is independent of the data model of the DBMS, the database designers are largely influenced by the data model of the DBMS. Firstly, the data model provides methodology for representing the objects of a particular application environment and the relationships among these objects (semantic role)[4]. Secondly, the data model is structured to allow a straightforward translation from the conceptual schema into the physical structure of the internal level of DBMS (representational role). Many of the early commercial DBMSs are based on either hierarchical or network model, as these are named as navigational systems. Many newer DBMS implementations are based on relational model.

The total view of the database is known as a logical schema, in that the schama is expressed in terms of a particular data model with associated operations. The logical database design leads to a precise definition (static) and processing information (dynamic) requirements of the database that are acceptable to all users of the database. Static requirements consist of the definition of the information that should be present in the database. This collection of meta-- information semantic is called conceptual (abstract or semantic) schema definition. Dynamic requirements consist of a definition of the transactions which will be run against the database[5]. Analysis of the total problem space of serials control inclusive of the data required and applications needed gives the logical database shown in Fig. 1. Entities are represented as circles and the underlying relationships are indicated by connecting arrows. For example, PUBLISHER, JOURNAL are entities and PUBLISHING is the one-to-many relations between PUBLISHER and JOURNAL.

DBMS provides user-invisible translation between the conceptual schema and the representational schema. As such, database application has the ability to define and refer data as in the conceptual schema. Despite the fact that the conceptual schema definition is independent of the physical storage structure, the database administrator should essentially have a clear and thorough understanding of the impact of his conceptual schema in the representational structure, since eventually physical storage structure is a striking factor in the performance of the system.

In network approach, information constructs (relations) represent a record (owners) linked to a set of record occurrences (member). These information constructs are called SET or COSET (COdasyl SET). In this paper, the term 'SET' is consistently used to mean the COSET. The logical database illustrated in Fig. 1 has been translated in DDL (Data Description Language) of DMS-1100 towards fostering the various requirements of the system, which are listed in Table 1. The schematic representation of the same is illustrated in Fig. 2. Rectangular boxes represent record types and the connecting arrow represent sets. The details of the set characteristics are presented in Table 2. It may be noted that the schema in Fig. 2 includes additional record types and sets which, as a matter of fact, are aimed towards the specificities of the DDL for alternative access paths and ease of processing. An extended facility of DMS-1100 is that it optionally produces a schema report, the detailed documentation of schema tables generated by the DDL processor. It is a highly useful tool for redesigning the schema declaration for eliminating the unnecessary overheads. The logical reasoning of the schema in Fig. 2 is easily perceivable. As such, the following discussion is limited to the controversial factors associated with the schema design.

The reason for the PUB-JR set being manual imposing an additional DML (Data Manipulation Language) instruction for connecting the records into the set, is the need to keep provision for changes in the relation – PUBLISHING. Had it been an automatic set, alteration in publishing could not be done without deleting the journal records. Being a member of PUB-JR set, JOURNAL record is accessible through PUB-JR set. Considering the frequent reference to this record, especially for recording of receipts, its location mode is defined as indexed sequential vide journal code (four character mnemonic code). In addition, three sets are generated to provide alternative paths to journals, vide full title, abbreviated title and subject category. While direct accesses through title and subject category are aimed towards online enquiries from users, abbreviated title is incorporated to promote towards indication of the availability of documents retrieved by the SDI/Retrospective Search Services through the Iron and Steel Online Search System[6]. The owner of sets EMPTY-TITLE and EMPTY-ABBR have null attributes. As DMS-1100 has no means of declaring OWNER AS SYSTEM, as proposed by CODASYL, a record occurrence is required to represent an owner. Therefore, the EMPTY record type holding owner records of EMPTY-TITLE, EMPTY-ABBR sets is defined as direct. Looking at the schema, one may wonder why the sets EMPTY-TITLE, EMPTY-ABBR and SUB-JR in which JOURNAL record falls as

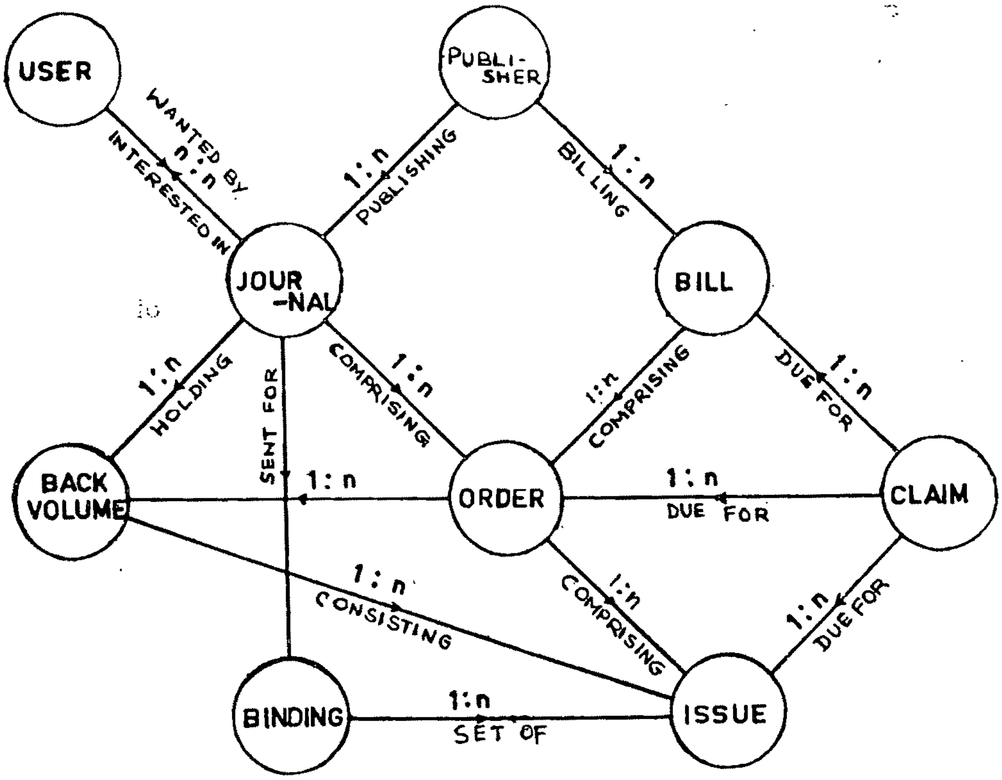

FIG 1 ENTITY RELATIONSHIP MODELLING OF SERIALS CONTROL DATABASE

Table 1

Function & Features of Serials Control System

Serials Librarian's Options	Automatic Functions
Addition/deletion of journals	Renewal Assessment slips
Users' routine slips change	Order placement in phases (country-wise)
Inputting of bills	Payment advice note to finance
Inputting of journal issues	Payment forwarding memo
Inputting of correspondence	Claim setting, resetting & issues:

Instructions for :
– Releasing issues for binding
– List of journals (by title, subject, country, frequency
– List of holdings
– List of gap issues (permanent)
	– Outstanding orders
	– Outstanding bills
	– Outstandings issues
	  – Gap issues
	  – Ineffective Subscription
	  – Issues stopped coming

Online enquiry	Routing slips
	Issue control list for Documentation Wing
	Requests for subscription period extension

Users' Option
Online enquiry

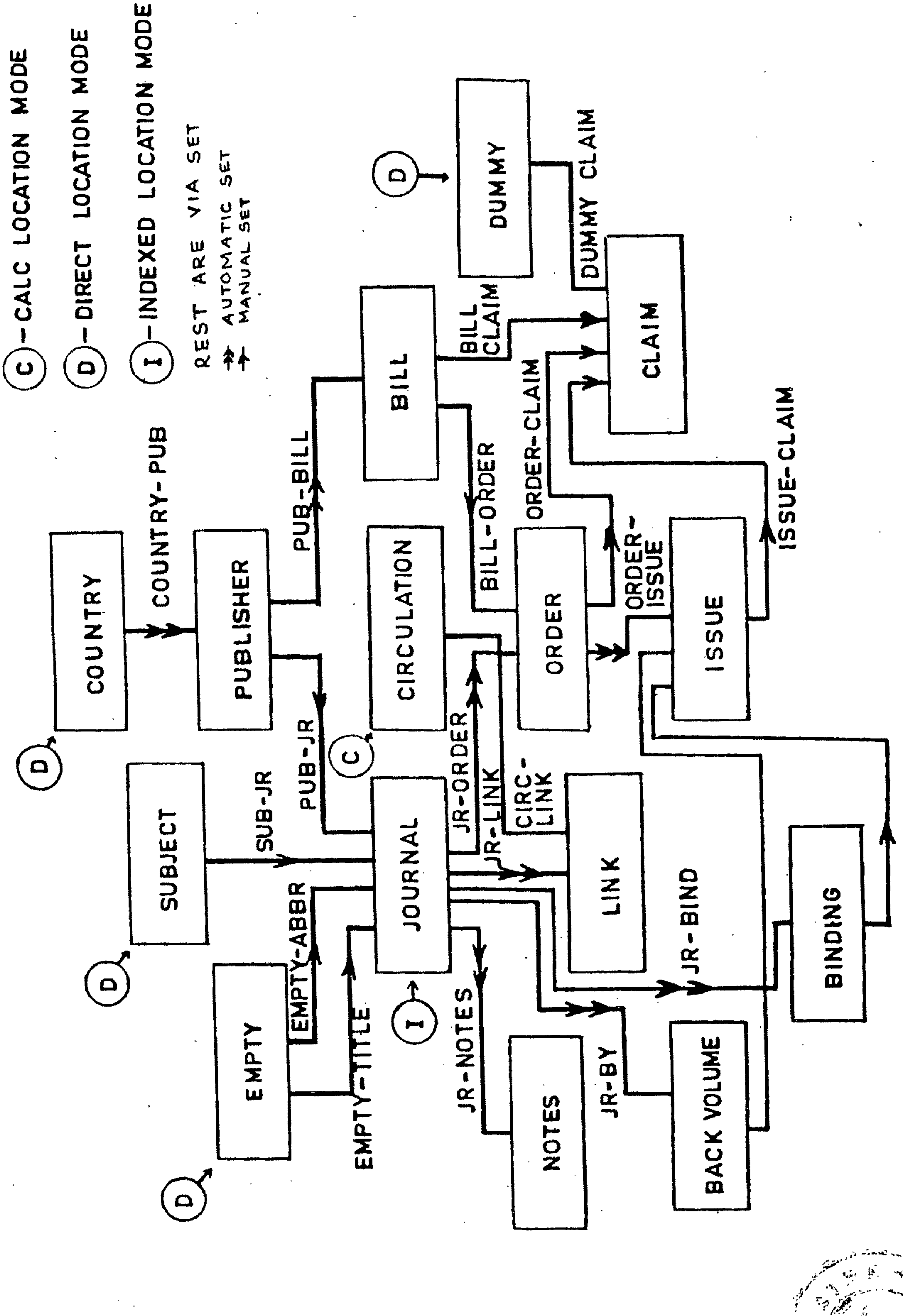

FIG. 2: SCHEMA - SERIALS CONTROL

Table 2

Details of Sets in Serials Control Schema (Fig. 1)

Set name	Order	Key	Mode	Insertion
COUNTRY-PUB	sorted	pub. code	chain	automatic
PUB-JR	sorted	jr. code	chain	manual
EMPTY-TITLE	sorted	journal	chain	manual
EMPTY-ABBR	sorted	jr. abbr.	chain	manual
EMPTY-SUB	sorted	subject	chain	manual
PUB-BILL	sorted	-	chain	manual
JR-LINK	next	-	chain	automatic
CIRC-LINK	next	-	chain	automatic
JR-NOTES	next	-	chain	automatic
JR-ORD	sorted	subscription period	chain	automatic
BILL-ORD	last	-	chain	manual
ORDER-CLAIM	next	-	chain	manual
ORDER-ISSUE	sorted	year, vol, month, issue no., copy no.	pointer array	automatic
BILL-CLAIM	next	-	chain	manual
ISSUE-CLAIM	next	-	chain	manual
DUMMY-ISSUE	sorted	claim date	chain	automatic
JR-BV	sorted	year	chain	automatic
JR-BIND	next	-	chain	automatic
BIND-ISSUE	next	-	chain	automatic

member should be defined as manual sets. This is a matter of database loading constraints.

In order to promote automatic generation of routine stips, CIRCULATION record type is introduced. The attributes of the record type are name, designation and group of each individual to whom intimation slips on receipt of journal issues of interest to them are to be sent. There exist many-to-many relations between the CIRCULATION and JOURNAL record types. As the same member record occurrence cannot have more than one owner record occurrence within a set, the LINK record type is incorporated to bifurcate the single set into two sets of one-to-many relations to offer many-to-many relationships[7]. Each record occurrence of LINK record type will form memberships in JR-LINK and CIRC-LINK and it will also have a pointer to the next record occurrence within each set. In spite of the fact that the ORDER record occurrence comes first and then the BILL, due to one-to-many relations between the BILL and ORDER records, the BILL-ORDER is defined rather than the ORDER-BILL. Here when an order record occurrence is stored, no owner record of the set BILL-ORDER would be present that forbids the set being an automatic one. Supplementary invoices virtually lead to many-to-many relations between order and bill entities. Due to their seldom occurrences, they are associated within the BILL record itself, instead of involving complexities of adding a set and a link record type. The PUB-BILL set follows sorted order, so that duplicate bills can be rejected on their entry.

Since subscription orders often span over a calendar year, the ISSUE record has to incorporate the year, in spite of its being redundant. Access to ISSUE record can be traversed from JOURNAL through JR-ORDER and ORDER-ISSUE, and to JOURNAL it could be any one of the four sets. Further sorted order facilitates the detection of missing issues and the most current issue received. To facilitate automatic detection of duplicate issues, an attribute indicating the copy number is included in ISSUE record type and is made as a key to the associated set. Despite the fact that claiming forms a dynamic information requirement of the database, in the logical view itself it is imperatively defined as a static requirement. Though this increases the complexities of the data structure, it certainly cuts short the claim processing to a great extent and also enhances the climing task. The conceptual schema, as illustrated in Fig. 1, prescribes one-to-many relations between claim and order, claim and bill, and claim and issue entities. Logically, it is very much true as on the same date several distinct orders, bill and issues fall due. Straightforward translation of logical schema into DDL may suggest that claims record should have been a owner of all the sets in which order, bill and issue fall as members. If so, what would happen when the temporal nature of claim records is removed? Hence, CLAIM record being an owner is ruled out. It is quite obvious that on the same day several claims of the same category may fall due, as such it forbids the same claim record occurrence being connected to several owners within the same set. Therefore CLAIM record is made as a member of all the three sets, ORDER-CLAIM, BILL-CLAIM and ISSUE-CLAIM, the set however is limited to one-to-one relation.

SUBSCHEMAS

Each application program has its own conceptual view, which is a subset of the universe conceptual view of the database. Subschema allows declaration of the subsets of the total database. Subschema allows declaration of the subsets of the total database known to an individual application program. That individual application need not be concerned with the universe of the database. Since a database may contain data which are relevant to and shared by multiple applications, this will ease writing, debugging and maintenance of programs. A run unit is linked with the portion of the database known to it through the respective subschema, as such, the rest of the database is insulated to a great extent. Further, any arbitrary number of subschemas can be declared and subschemas may overlap one over the others. Therefore, several subschemas with exclusively relevant record types, fields within records, and sets have been defined for application programs, inclusive of load routines.

DATABASE LOADING

The relationship between data description and data manipulation is the same as between declaration and procedures. Database load routines and application programs are the procedures. Loading essentially necessitates that the database administrator should have a thorough knowledge of the database structure. In certain situation, loading influences the schema definition in the sense that loading dictates the DDL specifications in certain directions. Several load routines have been written to load almost independently all the records and sets, so as to minimize the reloading operations to the requisite fragment of the database due to exceptions.

While loading of journal records as the PUB-JR set specifies sorted order on the same order as dictated by its location mode, simultaneously PUB-JR set is connected, whereas all other sets are connected consequently because each set has a distinct ordering sequence. This is primarily the reason that the sets EMPTY-TITLE, EMPTY—ABBR and SUB-JR cannot have an automatic insertion strategy. Record types EMPTY and DUMMY use their location mode for initial loading only, all further accesses are made by sequential traversing within the areas to eliminate several DML commands involving initialization of record number, page number and area name of the database key.

The CIRCULATION record type is initially loaded with all possible users in sequential order by increasing, the record number within a page and the page number when record exceeds the page limit, so that all records are packed.

APPLICATION PROGRAMS

Application programs are written in DML COBOL. There exists a corresponding application program for the each option listed in Table 1. On the other hand, all the automatic functions listed in Table 1 form a part of the respective application programs, except claim issuing, renewal subscription assessment slips production and renewal subscription ordering. These programs, are, however interlinked with the journal issues update (recording of receipt) program, for automatic invocation of the same. Because of the specific features of the DMS-1100, the DMR (Data Management Routines), which actually interfaces between the database and the application programs in host languages, occupies a huge memory. Due to limitations imposed by the memory management of the host computer that restrict the program instruction address to 65K WORDS, all application programs could not be collected as a single unit to provide menu-driven operation. This affects the user friendliness of the system and efforts are being made to resolve the problem.

CONCLUSION

The conceptual database has been designed which identifies the entities and relationships that will be eventually used in the database. In the process of translating the conceptual database into DDL specifications, entities corresponding to record types and relationships corresponding to sets have been further broken down to provide various supporting features and ease of processing. Underlying the logical reasoning of DDL, specifications for important but contrary factors are discussed. Database loading considerations and problems being faced in the application program towards user friendlines are also detailed.

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TRENDS IN INDIAN AGRICULTURAL RESEARCH: AN ANALYTICAL STUDY

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Investigates the trends in Indian Agricultural research with regard to its various branches, the extent of research collaboration, institutionwise productivity, channels of communication used, rank of journals and the scholarship of papers basing the entries noticed in the Indian Science Abstracts (1976-78, 1980-83).

INTRODUCTION

Science is growing at a faster rate, activated or catalysed by an increase in research. This growth or progress is accompanied by a change in the trends of research followed. The change wrought down is neither dramatic nor sudden, rather remarkably gradual and no demarcation can be made. On the other hand, this change in the trends can be traced by generating numerical data on the basis of the empirical evidence available. In the process of identifying the research trends in a field, it is, essential to analyse the various patterns that are evident in the literature of the field. The literature of any field, emerging from the investigations or research carried out is the best indicator or exposer of the trends extant in the field, as these reflect with consistency and regularity the research trends. Thus, from the remarkable features possessed by the literature, it is possible to draw powerful conclusions.

Agriculture, the field chosen, in the present analysis, is the profession of nearly three-fourths of Indians. This necessitated an improvement in the tools and techniques employed in agriculture. Consequently, scores of research workers engaged themselves in improving agriculture. With an awareness of the importance of agriculture, an upsurge in the research carried out becomes evident. This increasing research has resulted in the emergence of various trends. The identification of these trends is rendered possible by the application of bibliometric technique.

OBJECTIVES

The purpose of the present study is to bring forth the research trends in the field of agriculture. In this approach, an attempt is made to identify:

- The subjectwise distribution of the articles
- Authorship pattern
- Institutionwise productivity of agricultural literature
- Bibliographic forms of materials
- Authors' preference to the journals for publication
- The core periodicals; to apply Brookes model to estimate the number of periodicals that could contribute at least one relevant paper to the subject.
- The scholarship of papers in the field.

SOURCE JOURNAL

In the present study *Indian Science Abstracts* published by INSDOC was opted as the source journal, since it covers exhaustively the research work published in India and also the work done in India but published abroad. Necessary data for the study was collected from the journal between the periods, 1976-1983 excepting the literature published during 1979 because of its non-availability at the time of investigation.

ANALYSIS

Subjectwise Break Up

Agriculture, the basic science of human existence, has branched into various subfields, as a result of man's anxiety to explore the depth and vastness of the subject. This branching into narrow specialised fields was inevitable, because of the rapid growth and vast accumulation of the literature and a researcher's inability to cope with the flooding literature. Thus, agriculture, from its infant stage has developed through the ages and has branched into various subfields. Analysis of the literature, however, brings forth the trend that, of various subfields, research is more pronounced in the area of field crops, having 30.98% (6095) papers (Table 1). The next area is stock breeding, livestock, having 21.14% (4105) papers. The third place is claimed by agronomy, with papers accounting to 11.90% (2309). Table 1, a replica of the trends in the research front, clearly points out that the general field is being probed into deeply than most of the allied fields like fisheries, sericulture, etc.

Major output in the areas of field crops and stock breeding, accounting for 52% of the total output can be substantiated in the Indian context, considering that India is basically an agricultural country. Being an agricultural country, research is directed towards developing new techniques for improving the productivity of crops and cattle breeding.

Authorship Pattern

The trend of specialization in various subject fields, has resulted in the exponential growth of literature. This is also due to the complex and heterogeneous nature of subjects. Thus most of the disciplines being characterised by these factors have encouraged collaborative research. The research literature in agricultural field too is embedded to this trend.

An analysis of the agricultural literature reveals that two-author papers top the list throughout the seven years covered, followed by three and one-author papers. In all 8733 (45.45%) two author papers were encountered, followed by 5056 (26.31%) three-author papers, and 3160 (16.43%) single author papers (Table 2 & 3).

More than 83.56% of the papers are having two or more authors, this clearly reflects the trend of multiple authorship. This fact is further substantiated by the table indicating 'Author per paper'. Author per paper being 1.41 during 1976, has gradually increased through the years and has reached 2.36 authors per paper by 1983. On this basis, it can be concluded that the trend is towards multiple authorship.

Institutionwise Analysis

The agricultural scientists, engaged in research, belong to organisations like universities and colleges that can provide the conducive environment, essential for probing deeper. The environment includes the financial support, encouragement, equipment and tools, etc. A scientist seeks the organisation that can provide the necessary facilities for proceeding with research. It is, however, commonly noticed that the major output is from the universities followed by research institutions and colleges. An analysis of the data in agricultural sciences also reflects this trend. It can be observed from Table 4 that throughout the seven-year period the output from the universities secured the highest position accounting for 8837 papers (45.87%) of the total output. This finding is in consonance with the findings of the studies by Verma, et al[4] and Rangarrajan and Gupta[3]. The output from the research and scientific institutions ranks second with an average of 6846 (35.54%) papers. The output of 2440 papers (12.67%) from the colleges, which claims the third place is very meagre in comparison to those from universities and research institutions (Table 4).

Thus, the analysis clearly indicates that the output from the universities and research institutions together constitute more than 81 per cent of the total output. This can be accounted for the furthering of research. Added to this there is the time factor. In the colleges, time that can be devoted for research is less. This also puts a check on the research in colleges.

Bibliographic forms of Materials

Scientists communicate research results in a variety of channels. Of the various channels

Table 1

Subjectwise Distribution

Sl. No.	UDC	Subjects	Number of papers - Yearwise Analysis							Cumulative Number	Cumulative Percentage
			1976	1977	1978	1980	1981	1982	1983		
1.	631	Agronomy	347	390	355	253	261	413	290	2309	11.81
2.	632	Plant diseases, injuries, pests, crop damage and protection	394	238	347	107	185	236	194	1701	20.5
3.	633	Field crops	683	960	1129	694	909	1020	700	6095	51.66
4.	634	Arboriculture	213	404	367	232	325	405	267	2213	62.98
5.	635	Horticulture	225	336	351	207	337	313	368	2137	73.90
6.	636	Stock breeding, Livestock	376	615	642	656	847	472	497	4105	94.89
7.	637	Dairy and other Animal produce	42	62	69	60	68	39	33	373	96.80
8.	638	Insect and reptile management, Breeding industries, etc.	26	24	31	7	46	31	26	191	97.77
9.	639	Game and fish management, Marine husbandry	36	94	60	30	43	80	92	435	100.00
		Total	2342	3123	3351	2246	3021	3009	2467	19,559	100.00

Table 2

Yearwise break up of Authorship Pattern

Year	Number of Articles									Total
	1 Author	2 Authors	3 Authors	4 Authors	5 Authors	6 Authors	7 Authors	8 Authors	9 Authors	
1976	436	1042	552	195	37	11	1	-	1	2275
1977	507	1380	857	264	63	11	1	1	-	3094
1978	580	1492	872	298	54	19	3	-	-	3318
1980	269	987	647	202	56	19	3	1	-	2182
1981	440	1354	790	318	64	11	4	1	-	2982
1982	479	1462	728	259	47	15	2	-	-	2992
1983	449	1016	610	234	49	16	5	-	-	2379

Table 3

Yearwise Distribution of Authorship Pattern (in %)

Year	% Distribution of Articles					Author per paper
	1 Author	2 Authors	3 Authors	4 Authors	5 and more authors	
1976	19.16	45.80	24.26	8.57	2.20	1.41
1977	16.44	44.75	27.79	8.56	2.46	2.33
1978	17.48	44.97	26.28	8.98	2.29	2.34
1980	12.32	45.19	29.62	9.25	3.62	2.48
1981	14.77	45.41	10.66	2.68	3.08	26.49
1982	16.01	48.86	24.33	8.66	2.14	2.31
1983	18.88	42.68	25.65	9.84	2.94	2.36

Table 4

Distribution of Articles from Various Institutions

Sl. No.	Organisations	Number of Papers							Total	Percentage
		1976	1977	1978	1980	1981	1982	1983		
1.	Universities	972	1367	1552	970	1445	1431	1100	8837	45.87
2.	Research and Scientific Institutions	840	1140	1123	818	1057	988	880	6846	35.54
3.	Colleges	275	377	400	337	355	409	287	2440	12.67
4.	Unidentified	184	200	238	121	125	162	112	1142	5.93
	Total	2271	3084	3313	2246	2982	2990	2379	19265	100.00

available, primary journals being a formal, regular and orderly channel form the basic medium as a carrier of information. Journals are also considered to be one of the means of wider and rapid communication of research results. Thus, a scientist by preferring a journal for the publication of his articles, is assured that the results of his investigation will be widely communicated among the fellow scientists. Such a wider and rapid communication also adds to the total exploitation of the scientific information effectively and efficiently. This trend of author's preference for publication in the journals is commonly observed in the field of agricultural science also.

Analysis of the literature of all the seven years indicates that, journal articles are the most highly available form of literature accounting for 18,891 (96.39%) out of the total 19,559 bibliographic items. This is followed by the standards (1.39%), and conference literature (1.1%) (Table 5).

Ranking of Periodicals

Above 96% of the literature covered in this study has been published in 294 journals. This indicates profusion of journal publications caused by the increase in research. The increase in research, and the consequent flooding of the literature, necessitates the introduction of a new journal in a specialised branch or splitting of a journal in order to channelise research in a particular field and avoid scattering. This proliferation of journals has its repercussion on the budget and space of the library. The nonelastic financial resources of the library, therefore, demand the identification of the core journals, effectively covering the most significant literature of the subject, and thereby, making the acquisition extremely selective. The ranked list, prepared by the appplication of bibliometric techniques helps in the identification of the core journals in the field (Table 6).

Indian Journal of Animal Science tops the rank list with 1040 papers (5.51%), followed by *Indian Journal of Agric Science* with 1029 papers (5.48%), and *Indian Veterinary Journal* with 904 papers (4.79%).

Interdisciplinary nature of research has resulted in the scattering of literature of a particular subject in a number of periodicals. A graph prepared on the basis of Brookes model[1] to find out the number of periodicals contributing at least one relevant article related to the subject brought forth the fact that there were 8050 such periodicals in agricultural science (Fig.1).

Table 5

Bibliographic Forms of Material

Sl. No.	Forms of Material	Yearwise Distribution							Cumulative Number	Cumulative Percentage
		1976	1977	1978	1980	1981	1982	1983		
1.	Journal Articles	2271	3062	3246	2166	2977	2966	2203	18,891	96.58
2.	Standards	67	33	25	38	24	11	73	271	97.96
3.	Congress/Symposia/Seminars/Proceedings	-	19	-	17	-	20	157	213	99.04
4.	Patents	-	6	8	12	15	6	115	62	99.35
5.	Theses	4	3	5	13	5	4	18	52	99.61
6.	Monographs	-	-	1	-	-	-	1	2	99.67
7.	Reports	-	-	-	-	-	2	-	2	99.68
8.	Others	-	-	66	-	-	-	-	66	100.00
	Total	2342	3123	3351	2246	3021	3009	2467	19,559	100.00

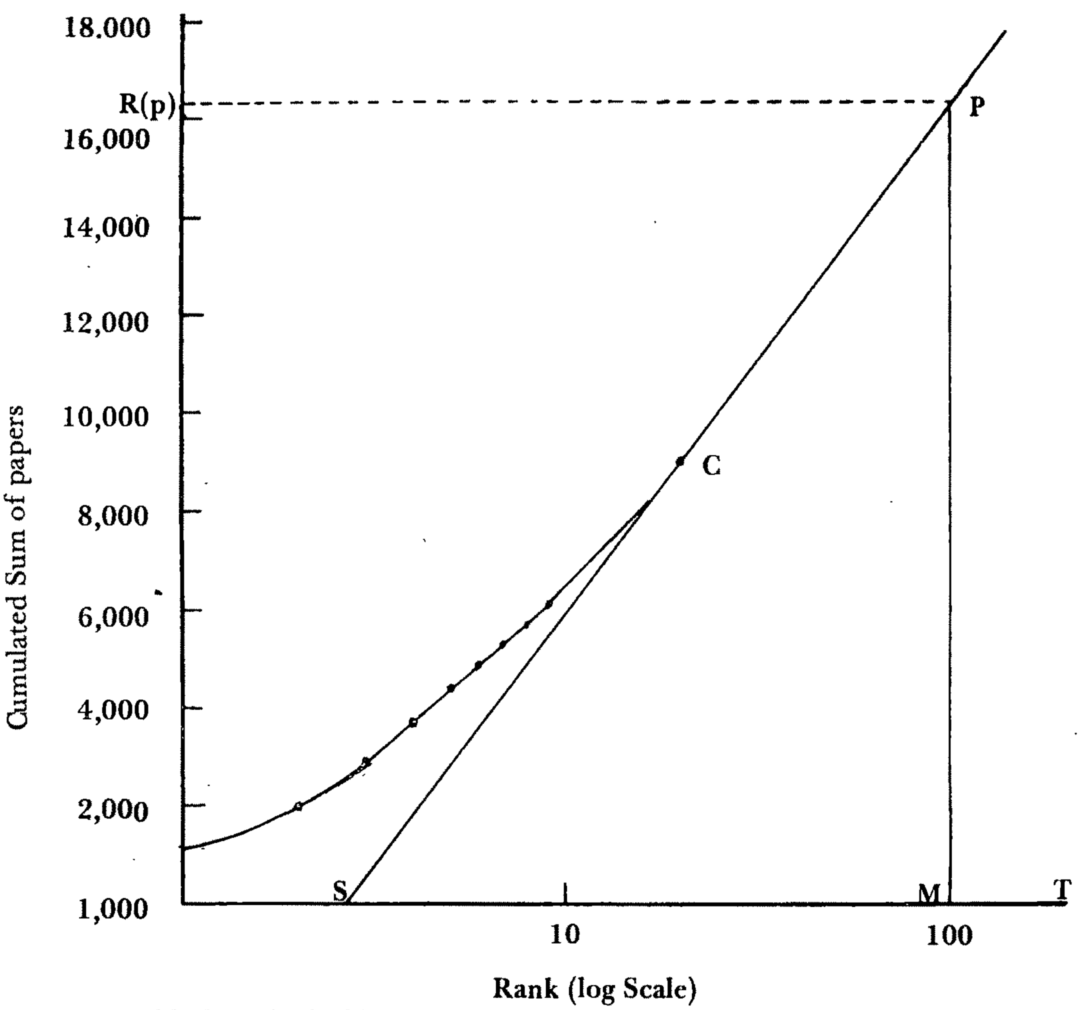
Table 6

Ranked List of Journals

Sl. No.	Rank No.	Title of the periodical	Country	No. of papers	Cumulative number	Percentage	Cumulative percentage
1	2	3	4	5	6	7	8
1.	1	Indian J. Anim. Sci. (1931)	India	1040	1040	5.505	5.505
2.	2	Indian J. Agric. Sci. (1931)	India	1029	2069	5.447	10.952
3.	3	Indian Vet. J. (1924)	India	904	2873	4.785	15.737
4.	4	Current Science (1932)	India	827	3800	4.377	20.114
5.	5	Pesticides, Bombay (1967)	India	637	4437	3.371	23.485
6.	6	J. Indian Soc. Soil Sci. (1953)	India	557	4994	2.948	26.433
7.	7	Indian Phytopath (1968)	India	454	5448	2.403	28.836
8.	8	Indian J. Hort. (1944)	India	387	5835	2.048	30.884
9.	9	Sci. Cult. (1935)	India	368	6203	1.948	32.832
10.	10	J. Mah. Agric Univ. (1976)	India	329	6532	1.741	34.573
11.	11	Mysore J. Agric. Sci. (1967)	India	326	6858	1.704	36.277
12.	12	Madras Agric. J.	India	309	7167	1.636	37.913

13.	13	J. Res. Ludhiana (1964)	India	297	7464	1.572	39.485
14.	14	Indian Forester (1875)	India	283	7747	1.498	40.983
15.	15	Livestock Advise (1967)	India	282	8029	1.492	42.475
16.	16	Indian Jagric Res. (1967)	India	272	8301	1.439	43.914
17.	17	Indian J. Agron. (1956)	India	268	8569	1.418	45.332
18.	18	Fd. Emg. Agri. (1980)	India	235	8804	1.243	46.575
19.	19	Indian Emg. (1951)	India	205	9009	1.085	47.660
20.	20	Progve Hort. (1969)	India	204	9213	1.079	48.739
21.	21	Andhra Agric. J. (1954)	India	186	9399	0.984	49.723
22.	21	Indian J. Mycol. Pl. Path. (1971)	India	186	9585	0.984	50.707
23.	22	S. Indian Hort. (1971)	India	179	9764	0.947	51.654
24.	23	J. Nucl. Agric. Biol. (1972)	India	177	9941	0.937	52.591
25.	24	Indian Fmr. Dig. (1968)	India	172	10113	0.91	53.501
26.	25	Punjab Hort. J. (1961)	India	167	10280	0.884	54.385
27.	26	Kerala J. Vet. Sci. (1970)	India	166	10446	0.879	55.264
28.	27	Ann Arid Zone (1962)	India	165	10611	0.873	56.137
29.	28	Geobios (1974)	India	160	10771	0.847	56.984
30.	29	Poult. Advis (1968)	India	154	10925	0.815	57.799
31.	30	Pestology	India	151	11076	0.799	58.598
32.	31	Indian J. Exp. Biol. (1963)	India	149	11225	0.789	59.387
33.	31	Indian Sug. (1951)	India	149	11225	0.789	60.176
34.	32	Proc.Natn.Acad.Sci. India (1931)	India	137	11511	0.725	60.901
35.	33	J. Plantn. Crops (1973)	India	133	11644	0.703	61.604
36.	34	Cheiron, Madras (1972)	India	123	11767	0.651	62.255
37.	34	Gujarat Agric.Univ.Res.J. (1975)	India	123	11890	0.651	62.906
38.	35	Proc. Indian Natn.Sci.Acad. (1935)	India	121	12011	0.64	63.546
39.	36	Indian J.Genet.Pl. Breed (1941)	India	116	12127	0.614	64.16
40.	37	Indian Perfumer	India	111	12238	0.588	64.748
41.	37	Seed Res. (1973)	India	111	12349	0.588	65.336
42.	38	Indian Poult. Gaz. (1917)	India	110	12459	0.582	65.918
43.	39	Fertil. News (1956)	India	109	12568	0.577	66.495
44.	40	Indian J. Anim. Health (1962)	India	108	12676	0.572	67.067
45.	41	Agric.Res.J. Kerala (1963)	India	107	12783	0.566	67.633
46.	42	J. Fd. Sci. Technol. (1964)	India	106	12889	0.561	68.194
47.	43	Trans. Indian Soc. Desert Technol. (1976)	India	105	12994	0.556	68.75
48.	44	Haryana Vet. (1962)	India	103	13097	0.545	69.295
49.	44	Indian J. Agric. Chem. (1968)	India	103	13200	0.545	69.84
50.	45	Fmr. Parliam. (1966)	India	102	13302	0.54	70.38
51	46	Lalbaugh (1956)	India	101	13403	0.535	70.915
163		Other Titles (Having Less Than 100 Articles)		5488	18891	29.039	99.954
214		Grand Total		18891		99.954	

SCALE - y axis - 0.5" = 2,000 papers



Graphical method of identifying the nuclear periodicals & estimating the number of periodicals contributing atleast one relevant article.

Bibliographic References

A discipline develops by banking upon the available literature in the field. The published literature of any field provides a base for new research. The number of references provided by a paper are further considered as a gauge to assess the scholarly level or merit of a paper, because when an investigation rests on the exhaustive use or exploitation of the precious literature, that investigation can be considered as scholarly, having been based upon proved facts. Different methods or scales have been used by different scholars to measure the scholarly status of a paper. A paper is considered scholarly by Price, provided it has more than ten references[2].

It is evident from the Table 7 that the field is flooded with papers having less than ten references. The ratio of the papers with less than ten references to those with more than ten is 76:24. It is further evident from the table that as the number of references per paper increases, there is a considerable decrease in the number of papers.

At this stage, when one proceeds to assess the scholarly merits of the papers in the field of agriculture, applying Price's method[2], it is found out that only one-fourth of the papers in

Table 7

Frequencies of Number of References per Paper Expressed as the Percentage of all Papers

References per paper	Number of paper	Per cent of total papers	Cumulative Per cent of total papers
0	14,945	76.409	76.409
10	726	3.711	80.12
11	564	2.883	83.003
12	492	2.515	85.518
13	423	2.162	87.68
14	355	1.815	89.495
15	280	1.431	90.926
16	260	1.329	92.255
17	213	1.089	93.344
18	181	0.925	94.269
19	128	0.654	94.923
20	133	0.679	95.602
21	106	0.541	96.143
22	88	0.449	96.592
23	67	0.342	96.934
24	65	0.332	97.266
25	46	0.235	97.501
26	51	0.26	97.761
27	43	0.219	97.98
28	32	0.163	98.143
29	24	0.122	98.265
30	26	0.132	98.397
31-40	128	0.654	99.051
41-50	50	0.255	99.306
51-60	32	0.163	99.469
61-80	33	0.168	99.637
81-100	21	0.107	99.744
101-200	34	0.173	99.917
201-300	10	0.051	99.968
301-457	3	0.015	99.983

the field are scholarly and the rest are non-scholarly with less than ten references appended to them.

CONCLUSION

Most of the patterns in the agricultural field discussed above conform to the general trend observed in most other healthy and growing disciplines.

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